# ENGINEERING AND MINING JOURNAL

JUNE 1960

A McGRAW-HILL PUBLICATION PRICE $1


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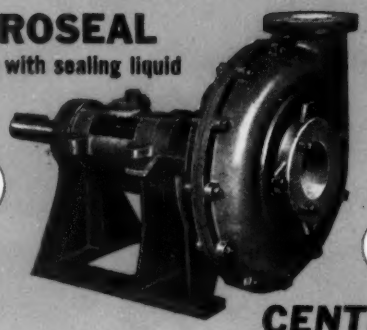
# Engineered pumping of abrasives corrosives acids

## INTERCHANGEABLE

**HYDROSEAL**
operates with sealing liquid



Split-Shell SLURRY and SAND Type
2" to 14"

Brochure No. 457

Brochure No. 557

**CENTRISEAL**
delivers the pulp undiluted

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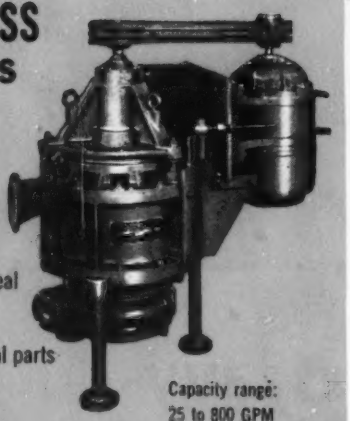

No stuffing box
No packing
No mechanical seal
No liquid seal
No exposed metal parts

Capacity range:
25 to 800 GPM

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## Flex-Check Valves
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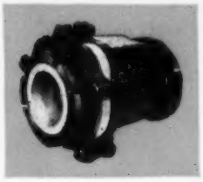

For pipe diameters up to 12"
For solids up to ¼"

Brochure No. 957

## RUBBER-LINED PUMPS

**HYDROSEAL**
VERTICAL
**sump pump**

Brochure No. 757

RUBBER-LINED or ALL-METAL
Four sizes: 1½" to 6"
Slurry, Sand & Dredge

## METAL PUMPS

## HYDROSEAL SAND and DREDGE Type

Capacities up to 14,000 GPM
Efficiency up to 75%
1½" to 14"

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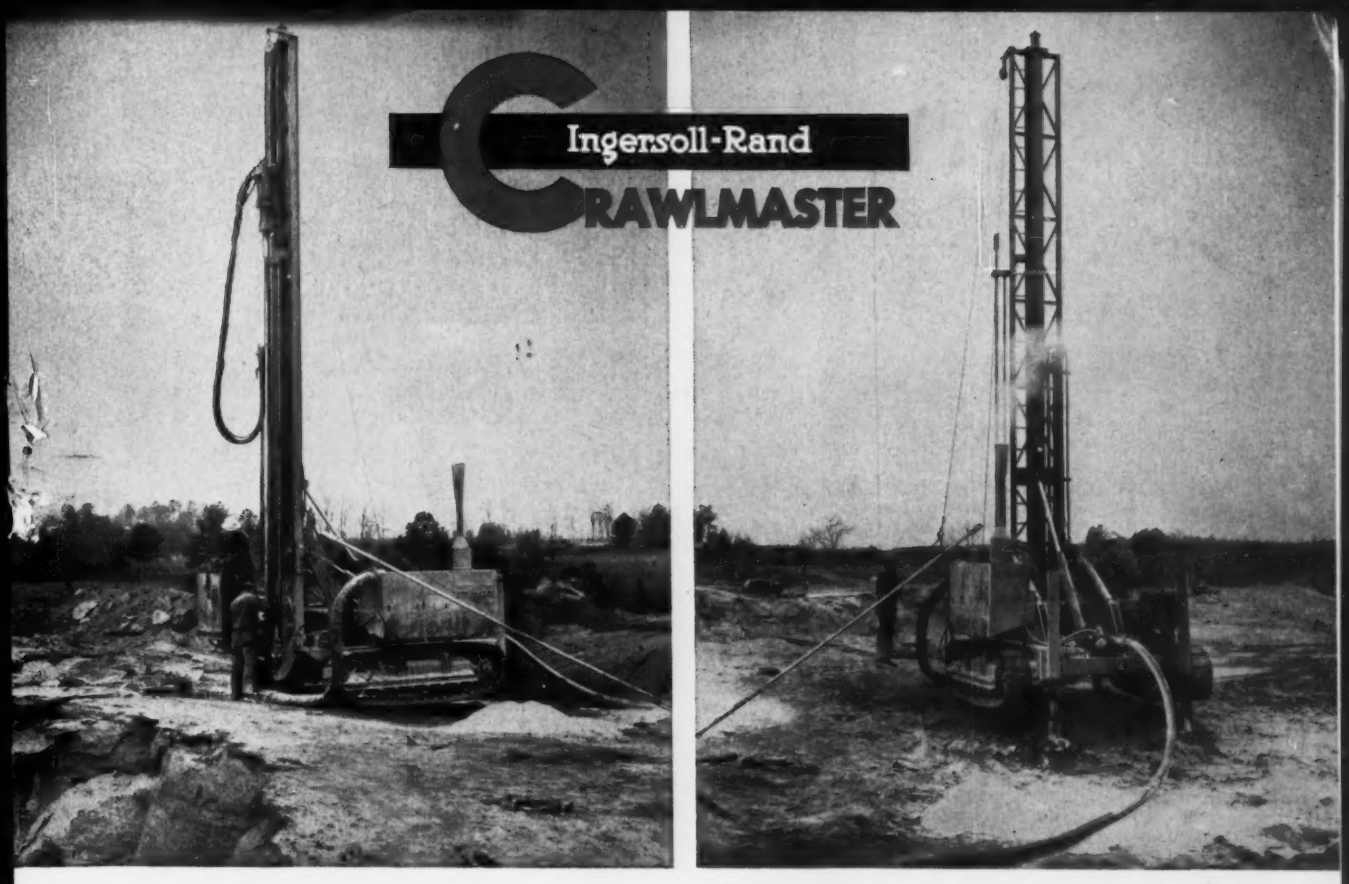
Brochure No. 357

To have an easy key to the correct type and size of pump, write us for "Technical Data" Brochure No. 357. For information in the category of your need, use the specified number. In the refinements of application, our engineers can help you.

**THE ALLEN-SHERMAN-HOFF PUMP CO.**
Dept. B—P.O. Box 635, Paoli, Pa.
*Representatives throughout the World*

ASH

# HYDROSEAL and CENTRISEAL
SAND, SLURRY & DREDGE PUMPS
MAXIMIX RUBBER PROTECTED




# NEW heavy-duty crawler drill

*MOST RUGGED*—tons of sound design
*MOST POWERFUL*—outperforms 5½" drills
*MOST VERSATILE*—4" to 6½" holes, vertical to horizontal

The new Ingersoll-Rand Crawlmaster is a *multi-purpose machine* that meets every requirement for percussion, rotary or Downhole drilling of 4" to 6½" blast holes in any type of ground. Here are just a few of its outstanding features:

**Constant-Pressure, Double-Acting Hydraulic Feed**—smooth, infinitely-variable power for drilling pressure or pulling stuck steels. Drill won't jump ahead in pockets or fissures.

**Simple Hydraulic Control Of All Tower Positions.** Tilting of tower on yoke and raising or lowering of yoke hydraulically powered by separate cylinders. All throttles outfront for easy operation.

**Throttle-Controlled Reverse Rotation** permits fast uncoupling of steels without having to climb tower to reverse drill.

**Ejector-Type Dust Collector** has no moving parts to wear out or maintain. A simple air-jet does all the work.

**Heavier**—Extra weight is reflected in sound design assuring extra stamina for the toughest drilling jobs. Has rugged, tractor-type crawlers with enclosed gear drive.

**Four 30" Stroke Hydraulic Leveling Jacks** permit accurate tower positioning with maximum stability on rough terrain.

**Hoist, Rod-Changer And Hydraulic Wrench** greatly simplify addition or removal of steel sections.

Interchangeable drills and rotation units permit one machine to be used for percussion, rotary or Downhole drilling of 4" to 6½" holes, taking power from a 600 or 900 cfm portable compressor. For a new high in drilling speed and economy, ask your I-R engineer for the Drillmaster story. Or send for Bulletin 4211.

**Ingersoll-Rand**
33A5 ♥ 11 Broadway, New York 4, N.Y.

A CONSTANT STANDARD OF QUALITY IN EVERYTHING YOU NEED FOR DRILLING ROCK

## *Mining Calendar*

Wyoming Mining Assn., Jackson Lake Lodge, Wyo., June 10-11

XXI International Geological Congress, University of Copenhagen, Denmark.

American Geological Institute, 2101 Constitution Avenue, N.W., Washington 25, D.C., Aug. 15-25

International Mining Congress, Hungarian Mining & Metallurgical Society, Budapest, Sept. 12-18

*National Mineral-Metallurgical Days, Association of Mining Engineers of Spain, Marques de Santa Cruz 14, Oviedo, Spain, Oct. 3-8

Rocky Mountain Minerals Conference, Salt Lake City, Utah, Oct. 5-7

American Mining Congress, annual meeting, Las Vegas, Nev., Oct. 10-13

Metallurgical Society, fall meeting, Sheraton Hotel, Philadelphia, Pa., Oct. 17-21

Electric Furnace Conference, Morrison Hotel, Chicago, Ill., Nov. 30-Dec. 2

AIME annual meeting, Chase-Park Plaza Hotel, St. Louis, Mo., Feb. 19-23, 1961

*International Symposium on Agglomeration, Philadelphia, Pa., April 12-14, 1961

(*Note: Both the International Symposium and the National Mineral and Metallurgical meeting will employ the extremely successful technique used at the International Symposium on Mineral Dressing, held in London this year. The technique, which has been highly praised by visitors to the London meeting, involves supplying preprints of the papers to be presented to all pre-registrants well in advance of the meeting dates. At the meeting proper then, simple abstracts of the papers are offered by the authors and time at the symposia is left for questions and discussion.)

## *Coming Up*

**Cost Cutting**—In upcoming issues of E&MJ there will appear several case histories with data on improved maintenance and some new applications of well known processing equipment.

In one story, the life of drill steel has been extended many-fold by a technique of retipping the steel at the mine in a hot salt bath. The steel is sawed off, the bit head re-formed, and new tungsten carbide inserts mounted, all in a smooth, successful operation by regular personnel at the mine.

**More on Tires**—A survey of mine tire maintenance and repair practices in U.S. mines has, like Topsy, "growed." Part I of the article appears in this issue. But the information so generously supplied by mines visited in the survey, with more data from the tire manufacturers, has pushed the article beyond its scheduled size.

94th YEAR OF PUBLICATION

# ENGINEERING AND MINING JOURNAL

**JUNE 1960**

A McGRAW-HILL PUBLICATION

*Volume 161, No. 6*

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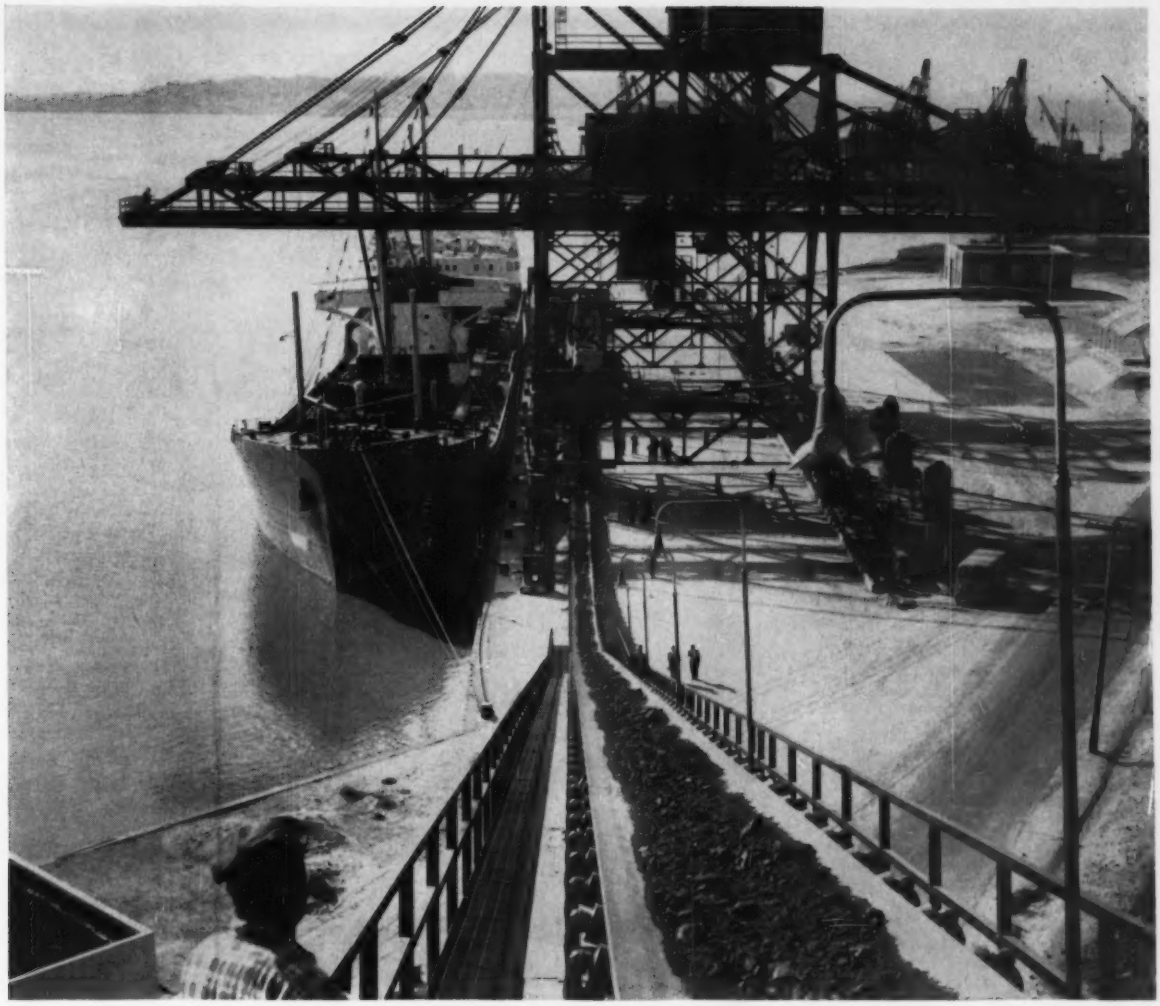
***Continued on p 4***



# Belt gets up and goes— unloads ore ships in a hurry

## After 9 million tons, B.F.Goodrich belt still going strong

At this pier, iron ore is unloaded from ocean-going freighters at a 2000-ton-an-hour clip. The conveyor belt rushes it up to waiting railroad cars. The whole system works so well that even the largest ore-carrying vessels can be emptied in less than 24 hours.

To stand the heavy loads, the speed, and to insure continuous operations, the engineers in charge selected a B.F.Goodrich conveyor belt. Special chemicals, developed by BFG, were added to the rubber to keep the belt "live" and elastic, help it resist the effects of air, sun, weather. Patented layers called "breakers" were built into the belt to increase impact resistance.

The trouble-free performance of the B.F.Goodrich belt has helped make this B & O Pier, Curtis Bay, Maryland, one of the biggest, fastest and most efficient ore-handling facilities on the East Coast. And after carrying nine million tons, the BFG belt is still in good condition.

But good as this record is, chances are that it will soon be bettered because of the improvements that are constantly being made in B.F.Goodrich belts. In recent years, for example, the use of improved rubber compounds and stronger fabrics has resulted in belts that can carry heavier loads farther and faster than ever before, and last longer doing it.

B.F.Goodrich distributors have full information on the belt described here. And, as factory-trained specialists in rubber products, they can answer your questions about the many rubber products BFG makes for industry. *B.F.Goodrich Industrial Products Co., Dept. M-852, Akron 18, Ohio.*

**B.F.Goodrich**

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WORLD NEWS OFFICES: Stockholm, Manila, Buenos Aires, Caracas, Havana, Lima, Santiago, Montreal, Toronto, Vancouver, Johannesburg.

Published monthly by McGraw-Hill Publishing Co., Inc., James H. McGraw (1860-1948), founder. Publication Office: 3rd & Hunting Park Ave., Philadelphia 40, Pa. See panel on p 2 for directions regarding subscription or change of address.

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# *Articles in this issue of*

# ENGINEERING AND MINING JOURNAL

*Continued from p 2*

**91 Gold in the "New Era"**
Speaking at the annua' meeting of the Copper & Brass Research Assn., Elliot Bell, publisher of BUSINESS WEEK, has suggested that the time has come for a halt to the vast outflow of gold which has characterized the U.S. trade scene since World War II.

**92 Mining Blueground at DeBeers**
In one of the most complete profiles of its kind, the general manager of DeBeers Consolidated Mines Ltd. and his staff offer the story of the greatest diamond mining property in the world. On the technical side is the case history of the switch from chambering underground to block caving. And, in a mineral dressing industry which frequently talks about mining one ton of ore for one pound of metal, DeBeers carries off the honors with its ratio of 1¼ lb of diamonds from 13,000 tons of blueground.

**183 The Guidebook Section Leads With Geology**
Two of the world's leading geologists, George M. Fowler and C. J. Sullivan, have contributed to this year's Guidebook. Mr. Fowler's article on "Structural Deformations and Ore Deposits," in the Oklahoma-Kansas mining field also contains a four-color tectonic map which illustrates the structure contours. Mr. Sullivan, whose writings in E&MJ in the past have generated a great deal of interest, discusses "The Origin of Sulphide Ores" in the article beginning on p 189.

**195 A Trio of Experts Discuss Air Pollution Problems**
The original concept of the E&MJ Guidebooks when they began back in May of 1954 was to provide a living "textbook" of modern mining. It was acknowledged at that time that no one Guidebook issue could give detailed attention to all the phases of mining and mineral processing; but that the collected Guidebooks should give it.

This year, the editors have emphasized the special area of dust control. Beginning on p 195, H. E. Soderberg discusses the selection of hoods, ductwork and dust collectors, with complete drawings and illustrations. In the second article, D. H. Wheeler and J. V. Day split the chore of defining a proper dust control system and describing the layout of the Gramercy, La., plant of Kaiser Aluminum & Chemical Corp.

**206 Modern Mining, Hauling and Earthmoving Techniques**
Swedish raising methods and South African shaft sinking are making news wherever underground mining is being done. From the London Symposium on shaft sinking and tunneling, the editors have extracted those two stories plus important developments on the use of the bucket wheel, rippers for mining, and the movement of ammonium nitrate explosives to underground and secondary blasting operations. The mining round-up continues into the area of electric-wheel trucks in mining, gas turbines, estimating mine machine production and finally into the future—mining from the bottom of the sea and the use of nuclear devices for mining.

# Rough going . . . yet maintenance problems eliminated with Chevron Vistac Oil

**High humidity,** dripping water, and mine dust could spell trouble for jack drills at this Cherokee Mine, near Randolph, Utah. It's 400 feet underground and a half mile back into the mountain. Yet despite high grit and moisture conditions, Chevron Vistac Oil reduces wear and lengthens equipment life for San Francisco Chemical Company.

**"We've eliminated maintenance problems** on our air operated equipment," reports Underground Mining Superintendent, Charles Stephens. "Chevron Vistac Oil keeps our drills and other machines functioning far beyond the usual service periods without repairs or breakdowns. We've used Chevron Vistac since 1952 on drills, tugger hoists, muckers . . . over 40 different machines."

**250,000 tons of ore a year** are mined from these rich phosphate deposits in the Cherokee Tunnel. Crews and equipment work 8 hours a day, five days a week, all year long.

**CHEVRON VISTAC OIL** cuts drill wear and power loss because it forms a tough oil film that clings tightly to moving parts, despite heavy shock loads, moisture and wide ranges of operating temperature. It's easy to work with because special additives reduce fogging—help prevent contamination from close air in mine tunnels.

**Why not try Chevron Vistac Oil? Chances are it can cut your costs, lengthen equipment life. Just call your local representative or write any company listed below:**

CHEVRON Industrial Lubricants

**STANDARD OIL COMPANY OF CALIFORNIA,** San Francisco 20 **STANDARD OIL COMPANY OF TEXAS,** El Paso

**THE CALIFORNIA COMPANY,** Denver, Colorado

TRADEMARK "CHEVRON," "VISTAC" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

# 94 YEARS OF MINING

**The following news items are reprinted substantially as they first appeared in the AMERICAN JOURNAL OF MINING, the publication which became *E&MJ*.**

**FRANCE, MARCH 1866—**

**TRANSMUTATION OF METALS**

Two French metallurgists, one of them the editor of the FRANCE MEDICALE, have announced that they have discovered a method of transmuting silver, copper and mercury into gold, all these, they say, being one and the same metal in different dynamic states. This idea is quite in accordance with that of the old alchemical writers on the subject; and the possibility of transmuting metals has been admitted by Sir H. Davey, Dr. Faraday, and other eminent chemists.

**PATENT CLAIMS—**

53,194.—Amalgamator. — John T. Staats, New York City:

I claim the amalgamation of metallic ores in a closed vessel, by the joint action of mercury, mercurial fumes and agitation resulting from the rotation of such vessel, as specified.

53,569. — Method of Extracting Gold and Silver from Ores.—Charles F. Carpsulter, Louisville, Ky.:

I claim the manner of using atmospheric air for the purpose of facilitating the extraction of gold and silver from ores, causing a separation between gold or silver and the ores of baser metals, and consists in introducing the said atmospheric air between the flame of a reverberating furnace and the cores which are spread on the hearth of the furnace.

**ARIZONA, APRIL, 1866** — Mining news from Prescott vicinity is very favorable. The shaft on the Vulture Ledge (gold), at a depth of 40 ft, shows richer rock than ever before struck in that section.


**The Specific Pill**

A Prompt and Certain Remedy for Spermatorrhea, or Seminal Weakness, or involuntary nightly or daily loss, however caused or however severe; while they will speedily correct those Morbid Conditions arising from the original disease or from Secret Vice. Price: $1 per box. Six boxes for $5, by mail.

J. Winchester & Co.
36 John Street, N. Y.


*This month in*

# ENGINEERING AND MINING JOURNAL

*Continued from p4*

## *Behind the By-Lines*

Here we are again, smack dab in the middle of a controversy. At the Education session of the AIME in New York during the winter a much-respected Canadian mining educator referred to the patron saint of mining as Ste. Barbara. Well, sir, there was a small caucus at a local watering place shortly thereafter which took some pretty strong exception to the remark, in favor of St. Patrick.

As always, and purely in the pursuance of peace in our time, we stuck our stupid neck out. "Bestir not your emotions, gentlemen," we said. (Or something like that.) "We will conduct a small research effort to determine if the said Ste. Barbara is truly the patron saint of mining." (We tend to talk that way at watering places after a while. It must be the Old World atmosphere.) Confident that the patronly Lady Barbara was a ringer, we began our study with a telephone call to St. Patrick's Cathedral, here in town. Who, we reasoned, would be more likely to settle the whole thing than somebody at Our Boy's own local section headquarters? Well, sir, we finally got through to a charming lady at the library of the Cathedral. We introduced ourselves.

"Who," we said (with a knowing chuckle) "is the patron saint of the mining industry?"

"Just a moment, sir," she said (very efficiently). There was a pause, and the rustling of pages. Then—"Saint Barbara, a Bavarian saint, venerated by miners, who was martyred in the Middle East. We have a picture of her in our files if you'd like to get a copy, sir. Sir. . . . Sir. . . ! !"

But we had gone.

We went straight to Prof. Al Schlechten of the Missouri School of Mines, whose school is the scene of the annual (and legendary) "day of rest" in honor of St. Patrick, patron saint of mining engineers.

An excerpt from his letter follows:

"It was in the spring of 1903 that the great discovery was made of the meaning of the words, 'Erin go bragh,' an expression so commonly associated with St. Pat. This translation, which spread like wildfire through the known world, meant . . . 'St. Patrick was an engineer.' Thus St. Patrick was discovered to be the first and greatest of all engineers."

Prof. Schlechten also notes that Missouri students in 1908, working under cover with Columbia students, declared the first general (and unsanctioned) cut of engineering classes. The rest is history.

While we were heartened by the good Professor's communique, we did notice that he referred throughout his letter to St. Patrick as the patron saint of engineers, but never specifically of mining engineers. In fact, he quoted Dean Wilson of Missouri to the effect that St. Patrick invented the "worm drive" as proof of the goodly man's association with engineering.

In the inset above are prints of paintings of the two worthies. We started our research with them, and, we must admit, we're with the two of 'em still.

**As one of our** Madison Avenue friends would put it, "Soul-wise, these are trying times."

# This all day sucker . . .

This hose can't kink when twisted, can't flatten when crushed even by the heaviest construction equipment. Acme-Hamilton Suction hose is reinforced with a continuous spiral of special non-metallic resilient reinforcement which gives it built-in bounce! The smooth-bore tube increases rate of flow, reduces turbulence. Costly down-time through accidental crushing is minimized with A — H Cord Suction Hose.

Check these features:

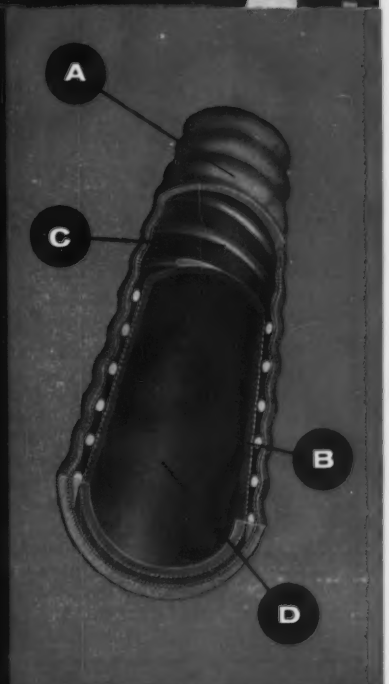
(A) Abrasion resistant red cover.

(B) Cotton duck plies.

(C) Rubber bonded plastic cord in 2½" and 3" sizes only.

(D) Smooth bore tubes.

Specify Acme-Hamilton cord suction hose when you order from your distributor, or write to Acme-Hamilton, Dept. S-3.




Acme Hamilton

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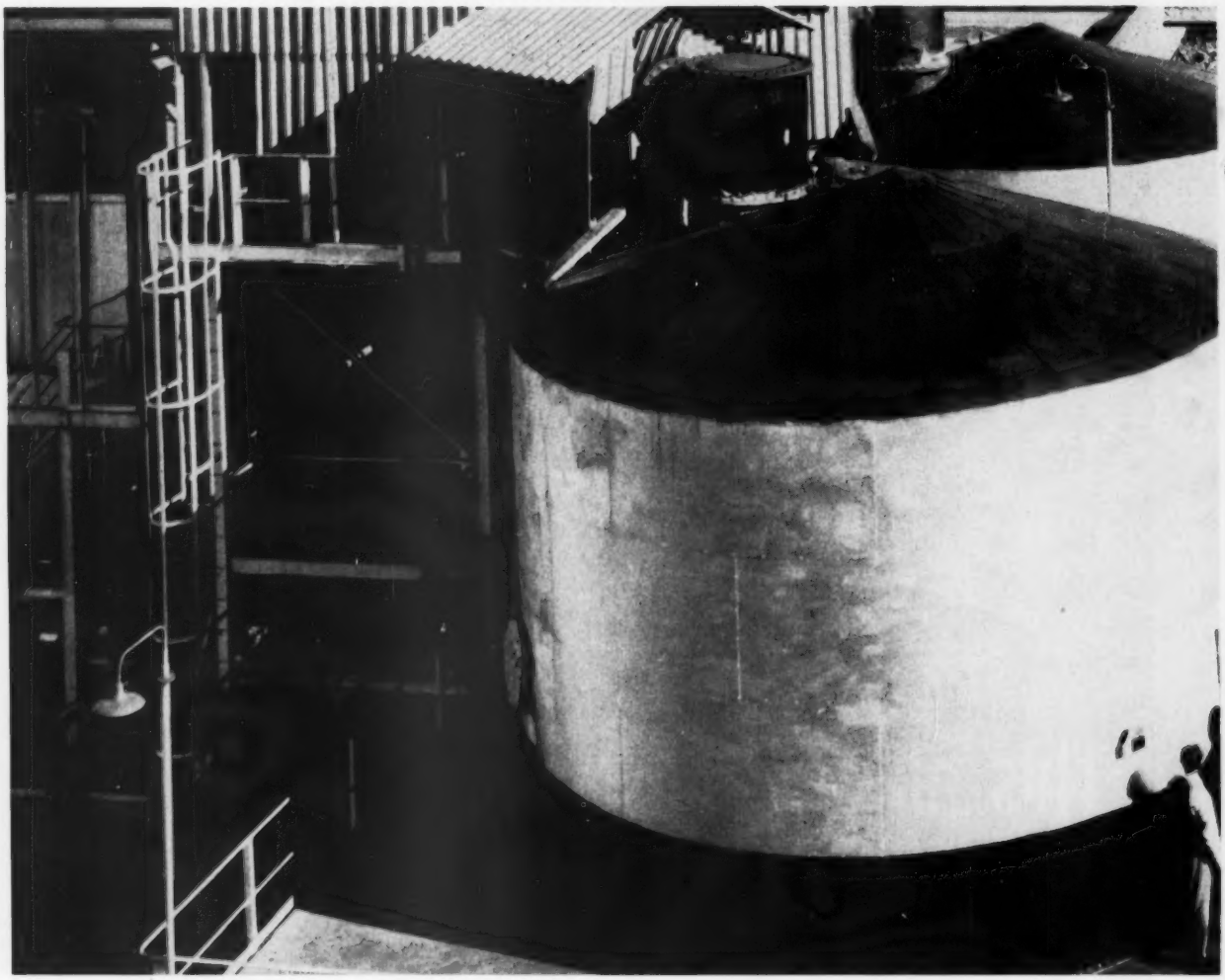
## *$SO_2$ production in the Transvaal*

# FluoSolids® PLAYS MAJOR ROLE IN



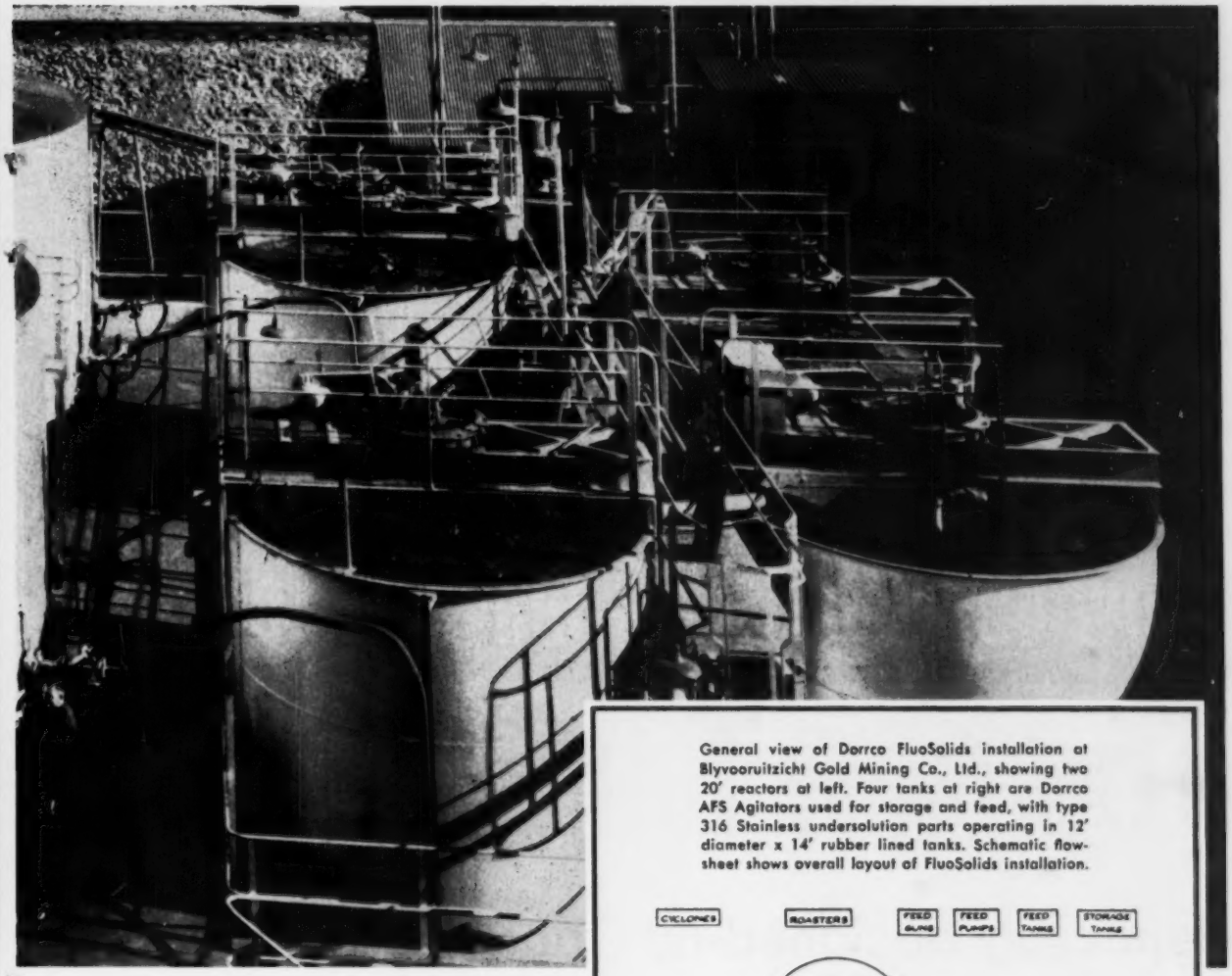
Blyvooruitzicht Gold Mining Co. Ltd.'s contact acid plant, near Johannesburg, has been cited as a model operation from an efficiency and appearance standpoint. Playing an important role in the overall effectiveness of the plant is the Dorrco FluoSolids System for pyrites roasting. Consisting of two 20' I.D. reactors plus auxiliary equipment, the roasting section produces sufficient $SO_2$ gas for the production of 150 tpd $H_2SO_4$ (100%).

On stream since October, 1956, the "Blyvoor" plant is but one of a long succession of highly effective installations in South Africa. Since this start-up, Rand Mines Ltd., parent company of "Blyvoor," has installed a second system comprised of two 18' I.D. reactors in their Harmony Gold Mining Co. Ltd. plant, bringing the total number of Dorrco FluoSolids pyrites roaster on stream to 21 in South Africa alone.

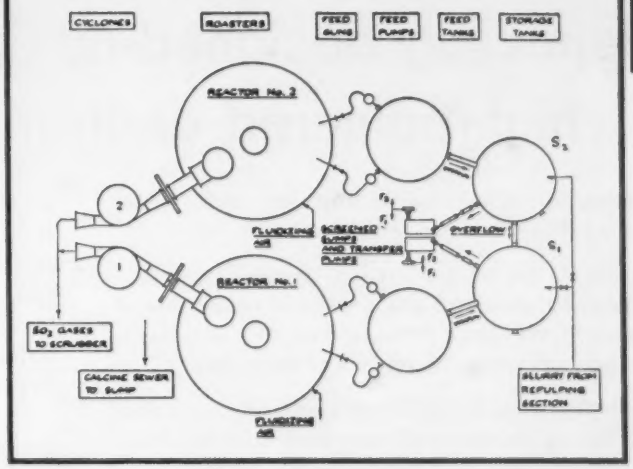
This system is additionally significant in that it includes many refinements over previous pyrites roasters erected in South Africa—among them an improved repulping system capable of handling a day's requirements in less than 6 hours.

Total feed rate for each reactor is 90.5 lbs/min. dry basis 42% S pyrite filter cake. Total gas to scrubber from both reactors is 31,700

# MODEL 150 TPD ACID PLANT



General view of Dorrco FluoSolids installation at Blyvooruitzicht Gold Mining Co., Ltd., showing two 20' reactors at left. Four tanks at right are Dorrco AFS Agitators used for storage and feed, with type 316 Stainless undersolution parts operating in 12' diameter x 14' rubber lined tanks. Schematic flowsheet shows overall layout of FluoSolids installation.




CFM at 1200°F, 12.5 psia. Gas strength averages 11-12% $SO_2$ on a dry basis.

Dorr-Oliver's associated company in South Africa, Edw. L. Bateman, Ltd., handled all equipment and engineering for the "Blyvoor" and Harmony roasting plants—another example of Dorr-Oliver's thorough-going service on every continent.

If there is a step in your flowsheet where intimate contact between solids and gases is essential, the Dorrco FluoSolids system of fluidization should be investigated. Just write Dorr-Oliver Incorporated, Stamford, Conn.

DORR-OLIVER

WORLD-WIDE RESEARCH • ENGINEERING • EQUIPMENT

Dorrco, FluoSolids – Reg. T.M. U.S. Pat. Off.

# The New Earth-Mover

## Especially designed by Goodyear for today's high-powered earth-moving equipment

As you know, today's earth-movers move bigger loads faster than ever before.

To meet the added burden imposed on rims, Goodyear has developed a complete new line of Earth-Mover Rims that are now 40% stronger – yet add an average of only 6% to rim weight.

With Goodyear Earth-Mover Rims you enjoy such additional benefits as a heavy-duty bead seat band driver – to prevent slipping under severest operating conditions. And you get the positive air seal provided by Goodyear's famous Tru-Seal principle.

Goodyear makes rims in widths up to 37″ and diameters up to 49″. To prevent premature tire and rim failure, it pays to buy and specify rims job-fitted by Goodyear. See your local rim distributor, or write: Goodyear, Metal Products Division, Akron 16, Ohio.

**Send for Free Goodyear Rim Catalog**

–84 pages of facts and pictures on Goodyear's complete line of rims for every type of vehicle.

Tru-Seal–T. M. The Godyear Tire & Rubber Company, Akron, Ohio

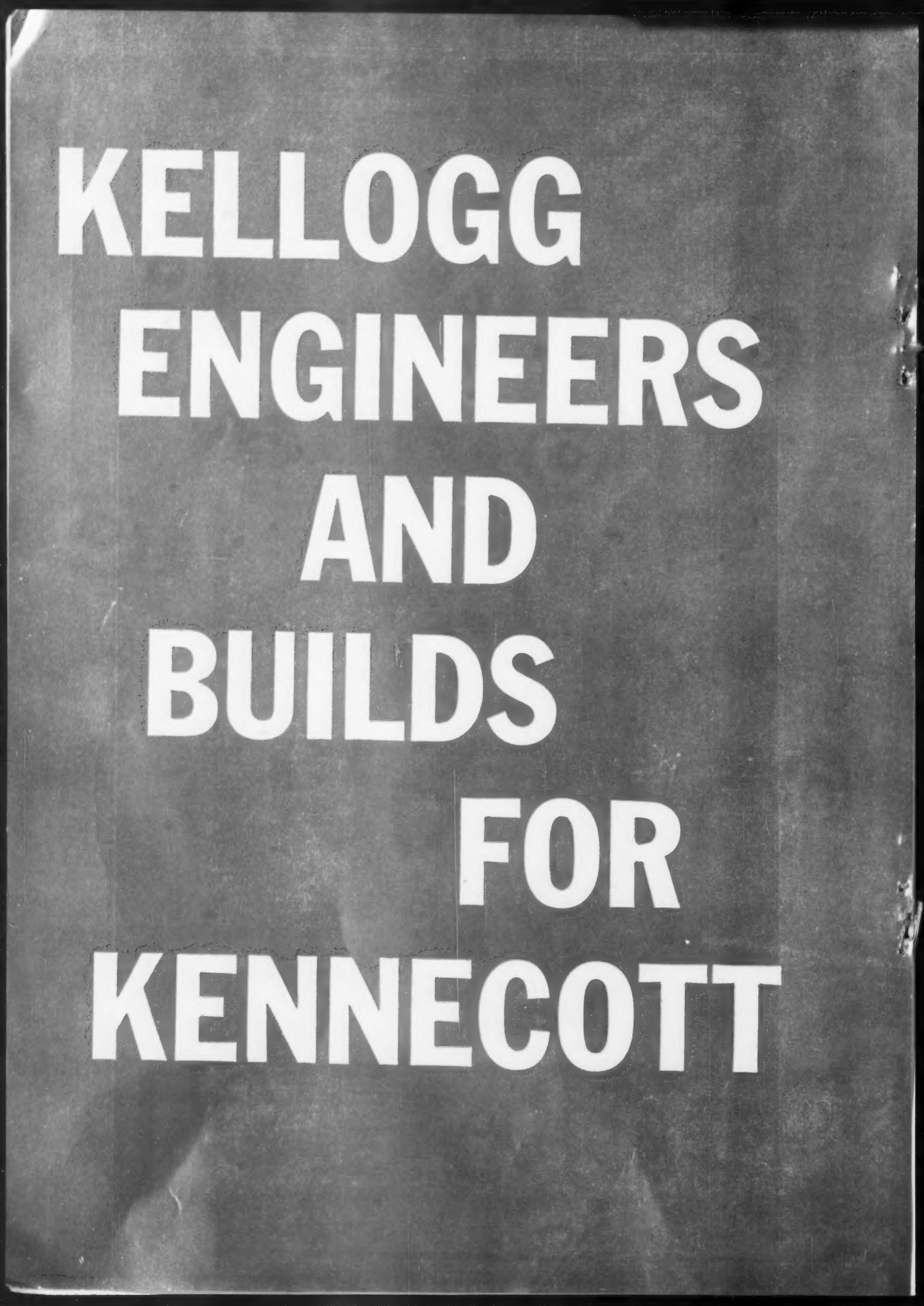
# Rim

Only Goodyear Rims have *Bond-A-Coat Finish*, for lasting protection against rust and corrosion.

*Buy and Specify RIMS by*

# GOODYEAR

MORE TONS ARE CARRIED ON GOODYEAR RIMS THAN ON ANY OTHER KIND


KELLOGG
ENGINEERS
AND
BUILDS
FOR
KENNECOTT

# KENNECOTT'S NEW $30-MILLION COPPER REFINERY DEMONSTRATES KELLOGG'S ECONOMIC APPROACH TO PLANT ENGINEERING, PROCUREMENT, CONSTRUCTION

Kennecott's new plant in Anne Arundel County, Maryland, is the newest and most modern electrolytic copper refinery in the United States. A model of efficient and economical execution, it is the result of close teamwork between Kennecott Refining Corporation and The M. W. Kellogg Company—to whom Kennecott assigned over-all responsibility for engineering, procurement, and construction.

This $30-million project demonstrates how large and complex plants can be designed and built for the optimum *predetermined* investment when all phases of the job are integrated into one unified operation by a single contractor. The method and the results are typical of the way Kellogg has worked with leading oil refiners, chemical companies and ore beneficiating firms.

Many design and engineering innovations resulted from this relationship. Among them were various ways to facilitate materials handling and expedite product flow. These included: a specially designed automatic anode take-off machine; straddle trucks for moving cathodes; and semi-automatic bundling for copper billets. Plant construction also was speeded by Kellogg, and erection costs cut, by production-line pouring—right in the plant—of 1,000 huge concrete cells, and by training workers on the spot to fabricate over 95,000 feet of plastic pipe at the plant site.

The complete story of Kellogg's engineering-procurement-construction assignment for Kennecott is available to you in a 12-page folder. You are also invited to send for Kellogg's brochure—"Planning the New Plant for Profits".

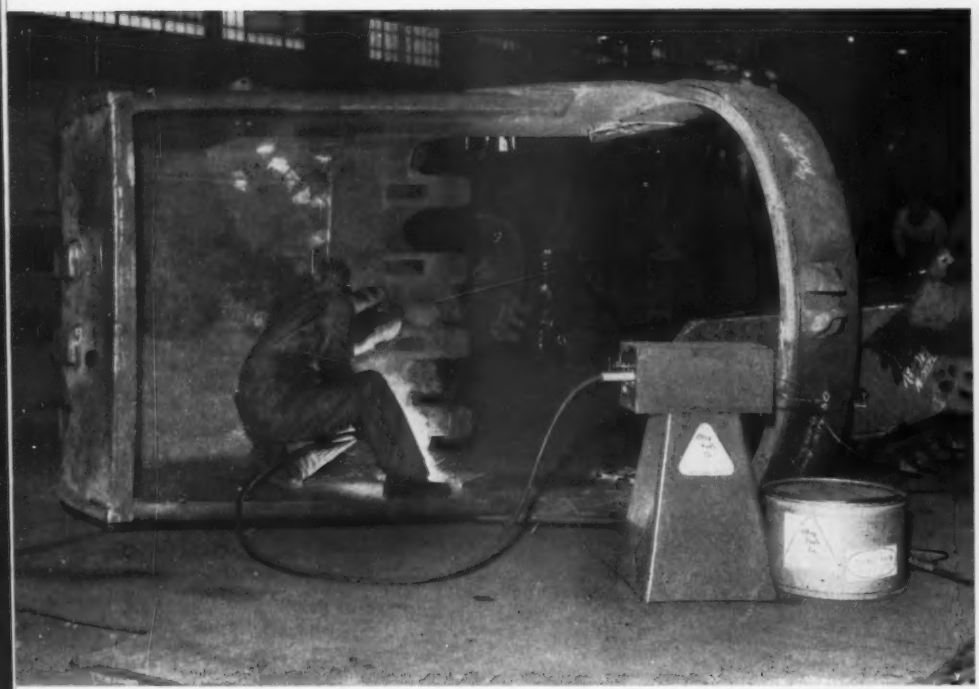
**THE M. W. KELLOGG COMPANY, 711 THIRD AVENUE, NEW YORK 17**

A SUBSIDIARY OF PULLMAN INCORPORATED

**Offices of Kellogg subsidiary companies are in Toronto, London, Paris, Rio de Janeiro, Caracas, Buenos Aires**

*Below is the new electrolytic copper refinery of Kennecott Refining Corporation (a subsidiary of Kennecott Copper Corporation) in Anne Arundel County, Maryland. Engineered and built by The M. W. Kellogg Company, this plant is expected to have a monthly capacity of 16,500 tons of 99.95% purity copper by mid-July.*

# *NEW WEAR-O-MATIC WH Produces High Strength Manganese Attachment Welds Equal to 308 Stainless For PAGE ENGINEERING COMPANY*



The Page Engineering Co. was founded in 1903 by Mr. John W. Page who originated the dragline method of digging. Today Page Engineering is the nation's leading manufacturer of dragline buckets, walking draglines and other equipment used in dragline operations.

High strength properties and crack free deposits are the two major requirements for welding alloys used to attach manganese parts to PAGE AUTOMATIC BUCKETS made of high strength alloy steel. Until recently, only type 308 stainless manual electrodes satisfactorily met both requirements. Other alloys have been tested from time to time but failed one or both tests leaving Page no choice but to continue using 308 stainless electrodes for critical joints.

Now, new Wear-O-Matic WH semi-automatic wire developed by Alloy Rods Company fills both the requirements by producing high strength properties identical to those of 308 stainless electrodes while depositing absolutely crack-free weld metal. The Page Engineering Co. has replaced most 308 stainless welding in their dragline bucket production with new Wear-O-Matic WH alloy, gaining the economies of semi-automatic open arc welding and retaining the same high strength requirements for manganese attachment welding. Page engineers report Wear-O-Matic WH gives them the additional advantages of faster deposition and smoother arc characteristics—better than any semi-automatic wire they have ever used in the production fabrication of dragline buckets.

You too, can benefit from the experiences of Page Engineering. For any application involving the high strength attachment welding of manganese, whether it be production fabrication of manganese parts or field maintenance, Wear-O-Matic WH will do the job better than any alloy you are now using and do it semi-automatically. Contact your Alloy Rods Company distributor or Hard Surfacing Specialist for specific application information. Or write direct to Alloy Rods Company, P. O. Box 1828, York 49, Pennsylvania.

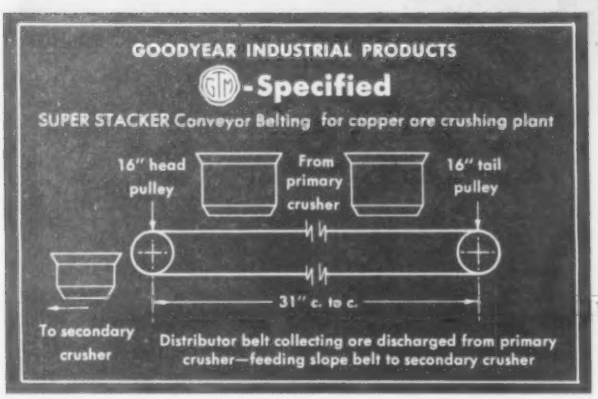
## ALLOY RODS COMPANY

**YORK, PENNSYLVANIA**

SALES OFFICES AND WAREHOUSES • NEWARK, PITTSBURGH, PHILADELPHIA, BOSTON, CHICAGO, SAN FRANCISCO, EL SEGUNDO, CALIFORNIA — DISTRIBUTORS IN ALL OTHER PRINCIPAL CITIES

**TWENTY YEARS OF LEADERSHIP IN THE DEVELOPMENT OF QUALITY ALLOY ARC WELDING ELECTRODES**

**To double a belt's tonnage, then to nearly double it again,** was a giant money-saving step at this big Western mine. For this key conveyor link between crushers was failing every 2 to 5 months—costing management 650 railroad cars of production at every change-over. But the G.T.M.—Goodyear Technical Man—had the answer in Super Stacker Belting. This first recommendation, alone, gave them nearly 9 months' use—and nearly 7 million tons, almost twice that of the last belt. Come time for replacement and he also suggested a minor equipment change. Result: a second Goodyear belt—with the same "specs" as the first—served a full year; handled a record 12,300,000 tons. Even then, only accidental damage caused replacement—by still more Goodyear belting.


GOODYEAR INDUSTRIAL PRODUCTS
GTM-Specified
SUPER STACKER Conveyor Belting for copper ore crushing plant
16" head pulley
From primary crusher
16" tail pulley
31" c. to c.
To secondary crusher
Distributor belt collecting ore discharged from primary crusher—feeding slope belt to secondary crusher

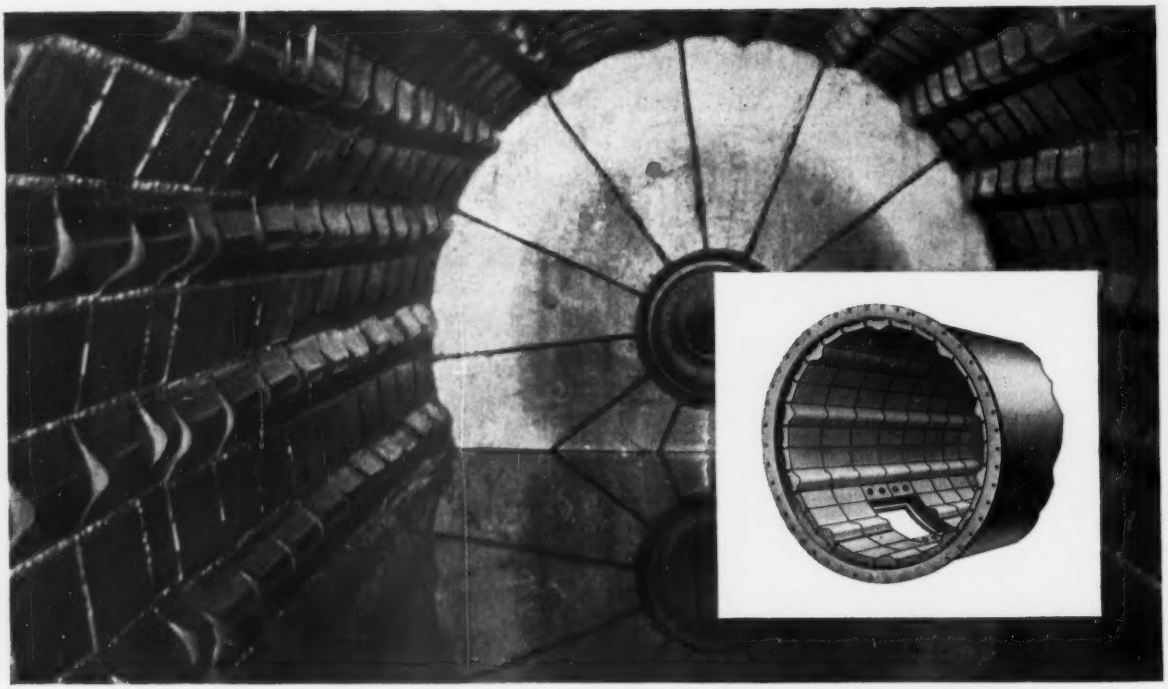
Remember—the G.T.M. never stops at recommending the best industrial rubber product for a job. He also volunteers tips on getting the most out of anything he specifies.

To take advantage of this no-obligation service, just contact him through your Goodyear Distributor. You'll find the name, address and number under "Rubber Goods" or "Rubber Products" in the Yellow Pages. Or write Goodyear, Industrial Products Division, Akron 16, Ohio.

Lots of good things come from

**GOODYEAR**

THE GREATEST NAME IN RUBBER



# 8 Reasons Why You Should Standardize with B&W Universal Liner Plates

### Better Performance with Lower Costs— Same Casting Fits All Mill Sizes

B&W Tube Mill Liners reduce capital, time and labor costs. Consequently, they reduce the cost of the material ground. Here are eight reasons why:

1. Lower Initial Costs—standardization eliminates chiller and pattern costs.
2. Longer Life For Liners—better quality control on a mass production casting, utilizing permanent molds, results in uniform wear. Ideal size for uniform chill and heat-treatment.
3. Longer Life for Different Applications—this is assured by selection of proper materials. Design is suitable for either chilled irons or wear steels.
4. Reduced Costs in Both Direct Labor and Outage —installation time is less because small size and weight of castings allows them to be handled easily, without cranes and with less fatigue for workers.
5. Reduces Costs in Storage Space—because small castings stack easily, little storage space is required. One design of casting interchangeable for all size mills also simplifies records.
6. Reduced Costs in Liner Inventory—standardization is possible because one design fits all diameters of mills. Standardization means quicker unloading and storage.
7. Reduced Costs on Breakage Claims and Delays for Replacements—small castings are rugged and almost impossible to break by handling. Large castings of hard, brittle irons sometimes break in shipment.
8. Reduced Costs in Determining Most Efficient Wear Patterns—you can get wear profiles consisting of all lifter ribs or all flats from the same castings, as well as a combination of both including straight or spiralled lifter pattern.

Liners are supplied in two nominal thicknesses, 1½" and 3" with 1½" high lifters. Castings are 6" wide x 12" long. Positive seating of small castings on mill shell means less breakage of castings under operating conditions. For additional information on B&W Universal Tube Mill Liner Plates write The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

8-471

# TRAYLOR-MADE

**TRAYLOR ENGINEERING & MANUFACTURING**

**DIVISION OF FULLER COMPANY**

**1622 MILL STREET, ALLENTOWN, PA.**

12-128

**TRAYLOR BULLDOG GYRATORY CRUSHER**

Type TC is the most advanced design of large capacity gyratory crushers. Built in six sizes with capacities ranging from 245 tons of a 2″ product to 4100 tons of an 11″ product, these gyratories feature Traylor original non-choking, self-tightening bell heads and curved concaves. Massive construction provides for shock absorption and, at the same time, all parts are readily accessible for maintenance. The Traylor patented dust seal provides a practical and efficient device for excluding dirt from the lubrication chamber. All of the features you want in your crushing machinery can be found in the Traylor TC Gyratory Crusher.

**TRAYLOR** . . . a name that means the very best in mining machinery, manufactures . . .

**Gyratory Crushers**

**Jaw Crushers**

**Rotary Kilns,**

**Coolers, Dryers**

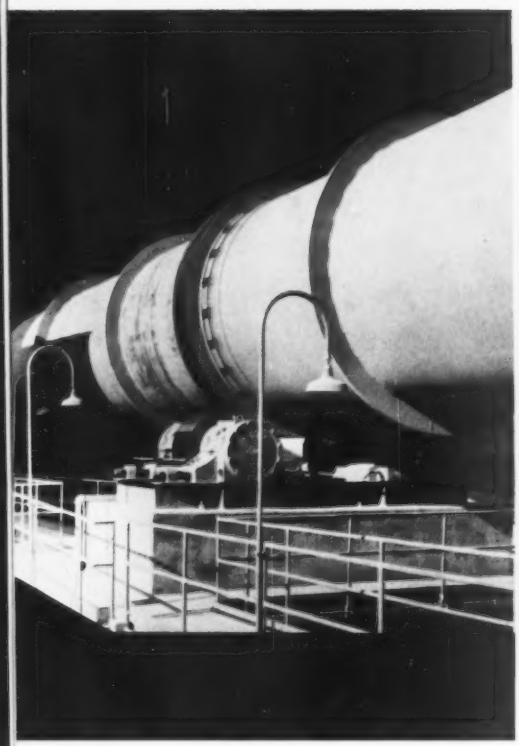
**Grinding Mills**

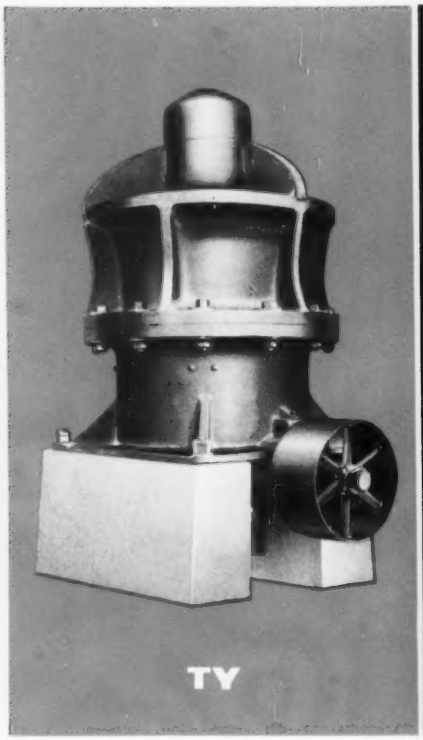
**Feeders**

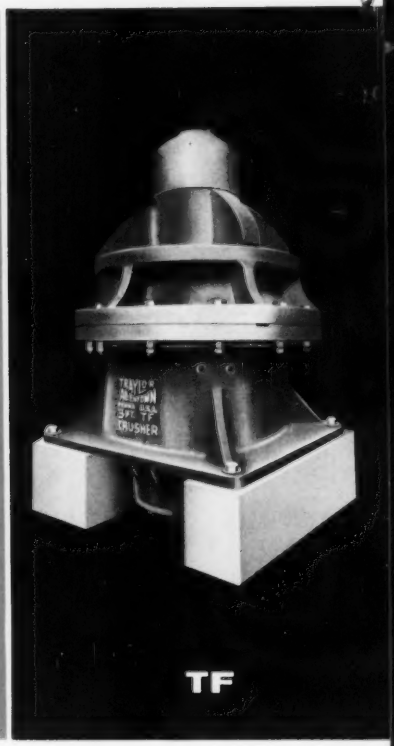
**Copper Convertors, Casting Machines**

# ROTARY CRUSHING

## *offer operating efficiency*






## ROTARY kilns

Hundreds of rotary kilns have been engineered, fabricated and delivered by Traylor Engineering. High standards of craftsmanship have produced the finest thermo-processing equipment available for calcining, roasting, chloridizing, volatilizing, sintering and nodulizing. The shells of Traylor-Kilns are made of heavy steel plate, automatically welded together, and Traylor engineers pioneered in the perfection of the easy aligning single roller supports. The full solid floating type of tire is mounted securely in place on the shell, and the main gears and pinions, made of steel, are reversible. Traylor Kilns have been built to 12′-0″ diameter, 450′-0″ long. For details on Traylor Rotary Kilns, Coolers, Dryers and Slakers, write for Bulletin No. 1115.

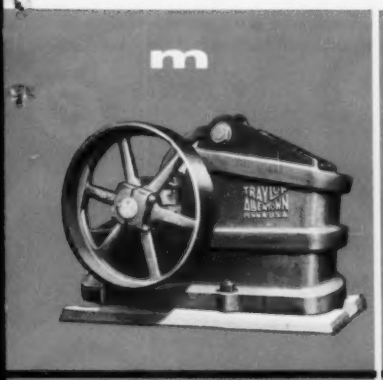
## SECONDARY crushers

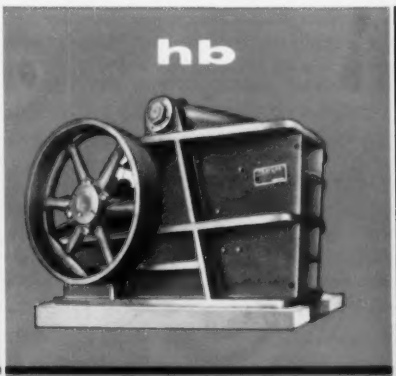
Traylor makes two types of reduction crushers: the TY in six sizes from 1′-3″ to 5′-6″ with feed openings from 3″ to 22″, and the TF Fine Reduction Crusher for operators whose needs demand economic production of $\frac{5}{8}$″ to $1\frac{1}{4}$″ material in large capacity. Both types require less head room because of their compact, simplified design and Traylor original curved concaves and self-tightening bell heads are used in the TY and TF Crushers. The design, construction and operational features embodied in these reduction crushers are the direct result of Traylor's long and diversified experience and leadership in the ore and stone crushing field.

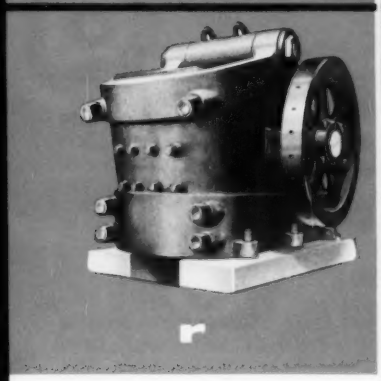
**NEW YORK:** 3416 Empire State Bldg. PE 6-0350
**CHICAGO:** 1213 Fisher Bldg. 343 S. Dearborn St. WE
**SAN FRANCISCO:** 564 Market Street YU 1-0677

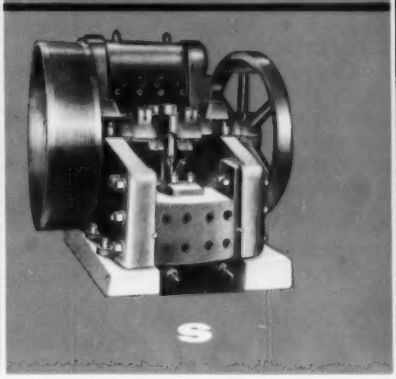
# KILNS AND MACHINERY

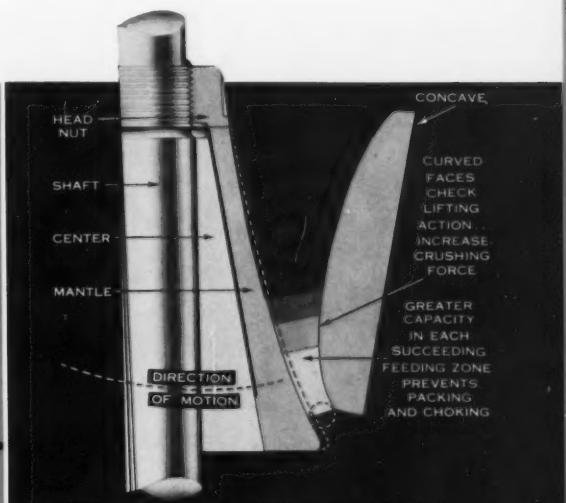
## *and long-life economy*




**CURVED CRUSHING SURFACES,** an original Traylor development, are shaped so that the faces are opposed to the direction of motion. Power requirements are reduced, even at finer settings, because more of the power applied is used as a direct crushing force.

By increasing the capacity of each succeeding feeding zone in the crushing chamber, choking and packing are practically eliminated.

## JAW crushers

Traylor Jaw Crushers are built in four types with 18 different size feed openings. Capacities range from four tons of ⅜" material to 1,000 tons of 11" material per hour. The four types of Traylor Jaw Crushers are One Piece Cast Steel, One Piece Welded Steel Plate, Sectionalized Cast Steel and Steel Plates, and Meehanite Iron, and all four are precision built to perform their rugged task efficiently. As the result of more than a half-century's experience in building crushers, Traylor has developed one of the most advanced groups of jaw crushers.

Traylor's patented swing jaw suspension and originally developed curved jaw plates account for greater capacity at finer settings and longer life of jaw plates. Traylor's curved jaw plates will outwear ordinary plates as much as 3 to 1. All frames are reinforced at critical points to provide strength without excessive weight. For more information on Traylor-Made Jaw Crushers, state your requirements and a bulletin will be forwarded to you immediately.

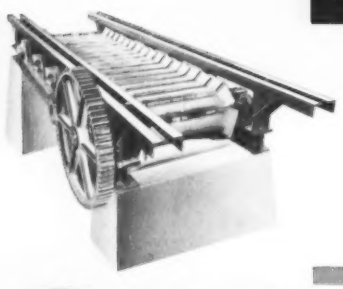
**FOREIGN SALES AGENCIES:** Lima, Rio de Janeiro, Buenos Aires, Santiago, Antofagasta, Oruro, La Paz, Montevideo, S. A.; Madrid, Spain; Oslo, Norway; San Juan, Puerto Rico; Manila, P. I.; London, England.

**AUSTRALIAN MANUFACTURER:** Jaques Bros., Richmond E-1, Victoria, Australia

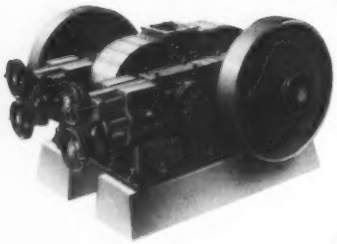
**CANADIAN MANUFACTURER:** Canadian Vickers, Ltd., P. O. Box 550, Place D'Armes Station, Montreal, P. Q., Canada

# *other fine* TRAYLOR-MADE *products*

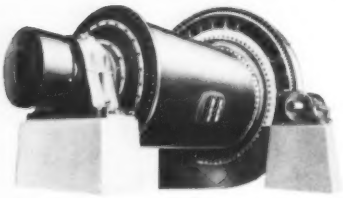
**in use by the mining industries throughout the world**



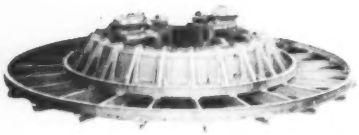
**TRAYLOR FEEDERS** are made in four types specially designed for application in the several steps of crushing, grinding, drying or calcining. These four are the Sheridan Grizzley Feeder, the Apron or Pan Feeder, the Table Feeder and the Slurry Feeder. Grizzley Feeders are made in sizes from 3′-0″ x 6′-0″ to 10′-0″ x 20′-0″ and Apron Feeders are adapted to the size and kind of material to be handled. Feeders are made in widths of 30″ to 84″ in any length required. All Traylor Feeders are adapted to the size and kind of material to be handled and are easily adjusted to vary their rate of delivery of material. For more on Traylor Feeders write for Bulletin No. 2114.



**TRAYLOR CRUSHING ROLLS** are built in three types. The Four Tension Rod type is capable of delivering large capacities and standing up under the most severe continuous service. Type AA and A Rolls are designed for lighter service. The range in size of the three rolls is from 18″ dia. x 10″ face to 78″ dia. x 24″ face with tension springs to develop pressures up to 40,000 lbs. per lineal inch of roll face. Write for Bulletin No. 6637.



**TRAYLOR GRINDING MILLS** are available in Ball, Rod, Compartment and Pebble Mills. Made in two types, overflow and diaphragm discharge, Traylor Ball Mills are built for either wet or dry grinding. They feature shell liners of manganese, high carbon, or chrome moly steel or nickel iron in plain, wave, cascade, lifter or rolled types with shells of welded steel construction. Trunions are cast integrally with the heads. Main bearings are made of Meehanite metal with larger sizes fitted with a high-pressure Alemite pump. Steel driving gears are precision-cut on Traylor's Maag gear generator. For full details on Traylor Grinding Mills write for Bulletin No. 11-121.



**TRAYLOR CASTING MACHINES** are built in two types: Circular and Straight Line. The heavily proportioned Circular Casting Machine is driven by two motors through separate gear trains, but with a single control. It is designed to run in either direction. The track is conical, and the turn-table supporting the mold platform runs on flanged conical rollers. Traylor Casting Machines have been built in sizes up to 40′-0″ and can be designed for anode, cathode, wire bar or pigs. Write for complete information.

# TRAYLOR-MADE

**TRAYLOR ENGINEERING & MANUFACTURING**

**DIVISION OF FULLER COMPANY**

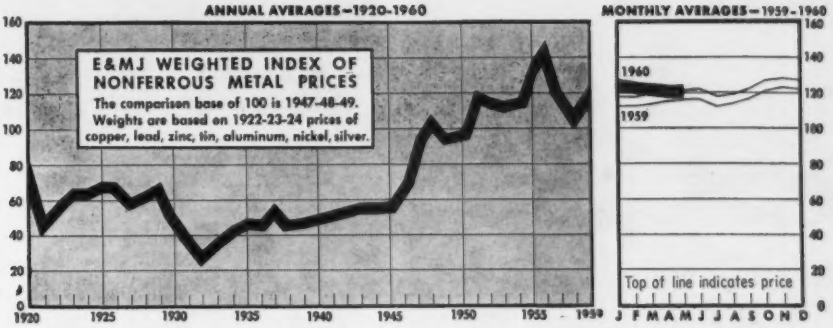
**1622 MILL STREET, ALLENTOWN, PA.**

**SALES OFFICES: NEW YORK • CHICAGO • SAN FRANCISCO**

**CANADIAN MFR.: CANADIAN VICKERS, LTD., MONTREAL, P. Q.**

# E&MJ OUTLOOK

## PRICES




## MARKETS

**E&MJ's nonferrous metals price index** remained unchanged at 125.8 for May.

**National Association of Purchasing Agents** reports that 47% of its members expect the second half of 1960 to be better than the first half; 39% see no change; and 14% expect it to be worse.

•

## AT HOME

**Reserve Mining Co.** announced plans to expand capacity of its Silver Bay, Minn., taconite project from 6-million to 9-million tons of pellets per year. Expansion will require additional coarse crushing, fine crushing, concentrating and pelletizing units.

**Auto sales,** key to metal sales, increased from 2.7-million for the first five months of 1959 to about 3.2-million for the first five months of 1960.

**United States Gypsum Co.** will build a plant at Baltimore, Md., to process gypsum produced in deposits in Nova Scotia.

**Vanadium Corp. of America** was the successful bidder for 1.5-million lb of vanadium pentoxide accumulated by the Atomic Energy Commission through purchase of uranium concentrates. Price offered was $1 per lb. Attempt to sell the vanadium stockpile in 1957 was unsuccessful.

**Early replies from E&MJ readers** on the proposed portable pension plan for mining engineers, E&MJ, May 1960, p 85, have been entirely favorable for the development of a plan. Additional response is invited.

**General Electric Co.'s** $2-million expansion to its Ft. Edwards, N.Y., capacitor manufacturing facilities will turn out capacitor-grade aluminum foil.

**Exide Industrial Div.** of the Electric Storage Battery Co., has signed agreements with 12 material-handling equipment manufacturers to develop the Exide fuel cell for electric industrial trucks. The Exide cell will use zinc and oxygen reacting in an electrolyte of potassium hydroxide.

•

## LABOR

**Mine-Mill** is stepping up its political action. Clinton Anderson and Tom Morris have been endorsed in New Mexico by the union, and Lee Metcalf and Paul Cannon in Montana. The union will not endorse a presidential candidate, although Adlai Stevenson is a favorite among union officials.

•

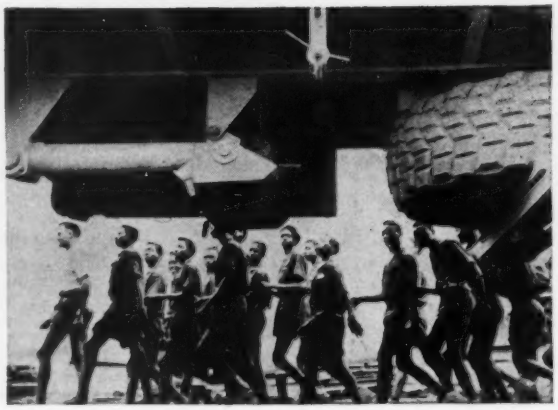
## ABROAD

**Aluminum Co. of America** has acquired an option on 30,000 acres of bauxite-bearing land in Jamaica. The site is west of Kingston in Clarendon Parish. Production is scheduled to start June 1, 1963. Ore will be shipped to Alcoa's Point Comfort, Texas, alumina plant.

**Gold producers in Canada** are receiving higher prices in Canadian funds because of the diminishing premium on the Canadian dollar in terms of U.S. dollar. When the U.S. dollar was worth 95¢, producers received $33.25 per oz in Canadian money. In late May they were receiving $34.65 per oz.

# THIS MONTH IN MINING

**FRIA's** alumina refinery, 96 miles inland from Conakry, consists of 26 precipitators (left), calcining kilns, and power house.



**YOUNG** Guinean apprentices follow their instructor to classes in machine shop practice and repair—part of Fria's program.

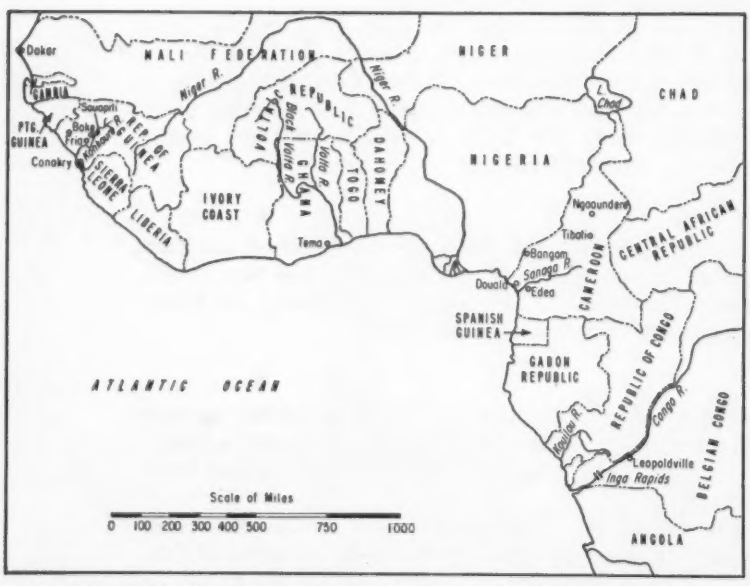
# Africa's Aluminum Takes a Giant Step

THE BABY aluminum industry of western Africa, which may very well grow into a giant, has taken one of its first important steps. The new Fria alumina plant in Guinea has gone into production, and in the first week of May, shipped its first two 6,000-ton lots of alumina. The plant will be the largest alumina works in Europe or Africa when it is completed.

Why may the baby grow into a giant? An aluminum industry needs two foods to satisfy its appetite: bauxite (the raw material), and electric power (to drive the reduction process). West Africa has both; at least four of her nations have bauxite deposits; and her hydroelectric potential, now barely tapped, is very likely the largest of any region in the world.

Between the baby's present infancy and its possible future greatness lie two problems. The first is capital, which is needed to bring any industry into being. The second, on which the first may largely depend, is politics. How the new West African nations perform in the bright light of independence, which they have achieved so recently, will very likely influence the willingness of the world's bankers to provide the capital that Africa needs. Both these problems have been solved, at least up to now, in the development of the Fria enterprise.

The consortium that operates the new plant is named Fria Compagnie Internationale pour la Production de l'Alumine. Six aluminum concerns from five nations own Fria. Olin Mathieson Chemical Corp., the only American partner, owns 48½%. Formed in 1956, Fria began construction of its alumina works in 1957; it started open-pit mining in early 1959, and by May 1960 its plant was producing 550 metric tpd of alumina.




**VILLAGE of Fria,** site of new Fria alumina plant, is in Republic of Guinea, some 50 air miles inland from ocean. Edea, Cameroon, is site of smelter.

Fria's bauxite deposits occur near the Guinean village of Fria, which gave its name to the consortium. The company has proved reserves of over 200-million metric tons of bauxite, and unproved reserves may well be over a billion. The fact that the ore is a tri-hydrate lateritic bauxite, readily soluble in caustic, makes possible the low-pressure digestion process that the plant uses.

The Bayer process, modified to suit the Fria ores, refines bauxite to give pure alumina. The bauxite, which is a mixture of alumina ($Al_2O_3$), hematite ($Fe_2O_3$), and silica ($SiO_2$), is crushed, then leached at atmospheric pressure with a concentrated caustic soda solution (the standard Bayer process uses high-pressure leaching in autoclaves). The caustic dissolves the alumina as sodium aluminate; filtration then separates the aluminate solution from a red mud residue that contains hematite, silica and some alumina. Seeding the liquor with previously-precipitated alumina trihydrate causes the dissolved aluminate to be precipitated as alumina trihydrate. When this is calcined at 1,000° C, hydration water is driven off and a product of 99.6% pure alumina results. The oil that the Fria calcining kilns and power plant burn comes from the Caribbean area.

When the plant reaches full capacity, it will be able to turn out 480,000 metric tpy of alumina. Because of the plant's inland location, Fria had to build a 96-mile one-meter-gauge railroad to connect it with the port of Conakry. Fria built handling facilities at Conakry (capital city of Guinea) for alumina and supplies; and the company and the Guinean government joined to improve the harbor and double the port's capacity.

Symbolic of the future of African

aluminum was the destination of Fria's first shipment. It was consigned, via the specially built French ore carrier "Paul Heroult," to Douala, Cameroon, some 1,500 miles down the African coast from Conakry; and thence it was shipped to Edea, Cameroon, site of the electrolytic aluminum smelter of Alucam, another European-owned consortium.

Alucam, owned by two French companies who are also partners in Fria, Pechiney and Ugine, and by the Belgian Syndicat Belge de l'Aluminium, built its smelter in 1958. It draws its power from a 125,000-kw hydroelectric plant on the Sanaga River. The smelter's capacity is 45,000 metric tpy of aluminum; and there have been reports that Alucam plans to double this.

Fria's first cargo to Alucam was given a ceremonial send-off, in which President Sekou Toure of the Republic of Guinea and officials of Fria's owners took part. Political uncertainty in Guinea has given some concern to the owners of Fria. The republic recently withdrew from the French franc zone; also, Soviet Russia has earnestly wooed the government of President Toure with technical assistance, financial credits, and trade. Nevertheless, president Stanley de J. Osborne of Olin Mathieson has credited Toure's government with "living up to every agreement"; and Olin Mathieson has an International Cooperation Administration guarantee from the U.S. government covering the company's investments in case its property in Guinea is expropriated.

Fria's second cargo was consigned to Mosjoen, Norway, for the Swiss and West German partners in the enterprise. Fria's owner companies are, besides Olin Mathieson, Pechiney and Ugine of France, which together own 26½% of the stock; British Aluminium Co. Ltd., with 10%; Aluminium Industrie A.G. (Swiss), with 10%; and Vereinigte Aluminium-Werke of West Germany, with 5%.

Eventually, about 1,000 men will operate the Fria works. About 2,000 are employed there now; and at the peak of construction in 1958, there were 7,000. The company is training African workers to replace Europeans to the greatest extent possible. To house the project's employees, the company built a new town, named Sabende, which can accommodate 5,000 people.

Along with the Fria and Alucam operations, vast potential for aluminum production exists in West Africa. When financing is arranged, many of these may become realities:

A new aluminum plant, with a capacity of 150,000 metric tpy, at Souapiti, on the Konkoure River, Guinea. Alugui is the potential builder, with ownership vested in Pechiney, Ugine, Aluminium Limited (Canada), Vereinigte Aluminium-Werke, Montecatini of Italy, Olin Mathieson, British Aluminium, and Aluminium Industrie. Decision to build such

*(Continued on p 308)*

# *As We Went to Press . . .*

Anaconda's capital expenditures for 1960, according to Charles M. Brinckerhoff, president, will be $35-million and will include: deepening of the Kelley Shaft (E&MJ, May, p 23); construction of a 5,000-ton concentrator at Yerington for sulphide ores (only oxides have been treated heretofore); development of a low grade open pit at Cananea, Mexico.

**Extension of the main shaft** at Hollinger's Ross Mine for an additional 1,050 ft and the establishment of seven new levels is due in 1962. The shaft currently extends 98 ft below the 1,500 ft level, a point reached in 1945. The gold producer began production in 1934, and diamond drills have indicated continuation of ore well below current workings.

Crushing facilities are already sufficient at the mine to handle the new production, according to the company, but there will be increases in hoisting speed and a smaller skip.

**Soviet overtures** in the area of Africa's burgeoning aluminum industry (see left) have struck a response in Ghana, according to reports. Some Ghanan officials were touring Russia in May, and apparently received tentative and unofficial offers of help in the mineral area and the Volta River development.

Kaiser Engineers are doing some development work on the Volta project, with the complete confidence and cooperation of Ghana. Kaiser is a part of the consortium which will develop a bauxite-alumina-aluminum industry in the new African nation.

**Formation of Ruby Hill Mining Co.** and election of officers took place last month. The Nevada mining company, which will spend $1-million to search for lead-zinc-silver, is a composite of Richmond-Eureka Mining Co. of Salt Lake City and Boston, and Eureka Corp. Ltd. of Toronto. Richmond-Eureka is largely controlled by United States Smelting Refining and Mining Co. Other participants include Cyprus Mines Corp. and Newmont Mining Corp.

Officers elected last month include: Fred Searls, Jr., chairman; F. S. Mulock, president; R. J. Hendricks, vice president; John R. Metcalfe, vice president; and Francis Fiske, secretary-treasurer.

**Import concession will be offered** at the Geneva meeting of GATT next fall on several ferrous and nonferrous ores and alloys and numerous steel products, but not on lead or zinc ores, concentrates or manufactures, if U.S. trade officials get their way.

The import offer list includes: nickel, manganese, molybdenum, vanadium, columbian-tantalum; ferrous alloys of chrome, manganese, boron, tungsten, cobalt, nickel titanium; zinc salts and compounds; steel products.

The list now goes to the Tariff Commission for setting of peril points and to the inter-agency Committee for Reciprocity Information for possible deletions.

U.S. negotiators will ask foreign concessions for aluminum and products, copper products, nickel, cobalt, molybdenum, titanium, tungsten and vanadium; ferroalloys including chrome and nickel and several iron and steel manufacturers.

# WASHINGTON IMPACT

## Highlights

**LEGISLATIVE DEATH RATTLE**—From Capitol Hill this month, a lot of noise and very little if any legislative action can be expected. As one spokesman for the western and southern domestic Mining Bloc puts it: "You are likely to hear almost anything about legislation on lead and zinc, subsidies, small mine aid."

In the closing days of the 86th Congress this election year, Senators and Congressmen concerned with the various pending mineral policy measures will concentrate on one main objective. That is to build as favorable a record as possible for bills aimed at increasing Government help for domestic mines for two reasons. One is to take that record back home to their district and state voters this fall with as much pride as possible. The other is to lay the best base for next year.

This means that if any measure faces a doubtful outcome on the floor of either House, its sponsors will try to avoid risking a defeat which would look bad in the campaign and hurt the bill's chance next session.

The main pending business affecting domestic mineral mining fits this pattern in each case.

**LEAD AND ZINC**—An intra-industry split in the lead-zinc industry, between international producers, smelters and small domestic mine operators, has left any change in lead-zinc import tariffs up to the Administration when existing import quotas come up for review this fall. Best bet is that the White House will raise zinc quotas, or replace them with slightly higher-than-present tariff rates, leave lead for next year.

The smelter group is pushing for a House Ways & Means Committee hearing on the bill introduced by Rep. Howard Baker (R.-Tenn.), which adopts the high 3-3½¢ duties recommended by a two-man Republican minority of the Tariff Commission in March. The smelters are not happy with the bill, but prefer it to nothing. However, Congressional Mining Bloc spokesmen are telling the smelters that passage of the Baker Bill would preclude further action by Congress next year.

**SMALL MINE AID**—The bill with the best chance remains a proposal by Sen. Robert Kerr (D-Okla.) and Rep. Ed Edmondson (D-Okla.) for Government price subsidies which would support mines producing 2,000 tons of lead per year with a 17¢ per lb domestic price, and the same quantity of zinc at 14½¢.

Approved by the House Interior Committee headed by Rep. Wayne Aspinall (D-Colo.), this measure still had not been cleared by the House Rules Committee for a floor vote as this issue of E&MJ went to press. Chances were regarded by Congressional observers as these:

Even if the bill were passed by the House, several Senators indicated they would try to broaden it to include similar support for other minerals when it reached their chamber. The Administration, which on paper still opposes the bill, might not fight its passage now, but would redouble its opposition if it were expanded to cover other commodities.

**THE SAME STORY**—This situation is even more applicable to a bill now before a House Committee to establish Government purchase incentives at bonus prices for small mine production of beryl, chrome and columbium-tantalum. Should this measure reach the Senate, it probably would be expanded to cover fluorspar, manganese, and possibly cobalt.

This is the bill on which the Administration suddenly reversed its opposition last month, reportedly with the urging of Vice-President Richard Nixon. In this case, as with small lead-zinc mine aid, an overloading with other minerals would virtually assure its defeat.

**MINERALS POLICY BILL**—Again a similar fate faces the bill sponsored by Sen. Gordon Allott (R-Colo.) to coordinate Administration minerals policy under the Secretary of the Interior. This bill, now pending in the House, is much like a resolution sponsored by Rep. Aspinall, which passed the Senate last year.

Aspinall is pushing the Allott bill, just as Allott sponsored Aspinall's resolution last year. But even House passage would likely come too late for Senate approval this session.

## Murray Slaps Metcalf On Depletion Statement

A POLITICAL CONTROVERSY over mine tax policy highlighted the announced retirement of Sen. James Murray (D-Mont.) last month. Murray, who has been regarded as the leading domestic Mining Bloc spokesman on Capitol Hill for most of his 25 years there, aimed a parting shot at his heir-apparent, Rep. Lee Metcalf (D-Mont.), who is the favorite to win Murray's seat in the Senate next fall.

Murray's criticism was directed at a speech by Metcalf in which the Congressman expressed "grave doubts that the (tax depletion) percentage allowed on oil, gas and minerals has any relation to the actual depletion," and indicated he felt "that the amount of the tax exemptions are too great."

Metcalf is a member of the House Ways & Means Committee headed by chairman Wilbur Mills (D-Ark.) which held extensive hearings this session on tax depletion allowances and plans legislation to tighten what some Congressmen regard as "loop-holes" in the law next year.

Murray said that "in making this irresponsible statement, Congressman Metcalf, who has deserted his post on the Ways & Means Committee to run for the Senate, stabbed the industrial community of Montana and the men who work in the mines of Montana in the back."

Murray concluded that if Metcalf has "thought out the effect of what he is advocating, and how it would wreck the economy of Montana and weaken the national security, it is indeed fortunate for Montana and the nation that he has deserted his post on the Ways & Means Committee.

## Weller of UIA Protests Olson's AEC Appointment

ANOTHER CONTROVERSY, this one directed at Atomic Energy Commission general counsel Loren K. Olson was unleashed by domestic uranium producers—in an apparently unsuccessful attempt to block his eventual Senate confirmation as an AEC commissioner late last month.

In a last-minute telegram to Joint Atomic Energy Committee Chairman Clinton P. Anderson (D-N.M.), Uranium Institute of America executive vice-president Gordon A. Weller charged that Olson had authored raw materials policy changes which raised industry doubts about its position on his nomination.

What annoys the uranium producers, Weller told committee members in person, is Olson's role in limiting 1962-66 AEC purchases of domestic concentrate to "appropriate quantities" at the set price of $8 per lb. Weller said this language gives the AEC power to cut back domestic production and set production operations and rates in negotiating milling contracts.

Weller also charged that embarrassment over Canadian purchase cutbacks and domestic contract stretch-outs had virtually stripped AEC raw materials chief Jesse Johnson of his responsibility.

Olson promptly denied he was the sole author of the language, and said he worked closely with Johnson on the disputed November 1958 order. As for charges that Johnson's responsibility was on the wane, Olson said: "Those of us who know Jesse also know this is far from being true."

## Justice Dept. and FTC Clear Aluminum Makers

A HOUSE INQUIRY into aluminum pricing policies, aired by the House Small Business Minerals Subcommittee last month, revealed that Justice Department and Federal Trade Commission have in effect cleared major producers of charges of marketing and pricing illegalities levelled by small fabricators, smelters, die casters and extruders.

American Die Casting Institute's associate secretary Richard E. Kellers told the committee that Justice Department had closed its file on the case, and that FTC held it open only for the formality of awaiting the House hearings.

The two agencies had been drawn into the case by two previous similar probes. Processors complaints included producers' molten metal contracts, export expansion, mergers, and pricing policies.

## Castro Squeezes Nicaro

THE NICARO NICKEL MINE may close down, or at least curtail its production in face of Cuban Prime Minister Fidel Castro's refusal to let its output be shipped to the U.S. without a prohibitive 25% export tax levy. GSA director Franklin Floete admitted under sharp Congressional Committee questioning last month that the Cuban government had refused to clear the U.S.-owned mine's April shipment.

Technically, the dispute is still up for official discussion between Washington and Havana. But indications in Washington are that both sides will stand firm. GSA, which is in charge of the mine, contends that a pre-Castro treaty makes Cuba's new mine export tax invalid for Nicaro. Castro suspended the tax for a three-month grace period, which ran out last month.

The market effect of Nicaro closing down would not be felt for some months, because of current abundant supplies. But the rapidly deteriorating U.S.-Cuban relationships make it likely that no solution will be found as long as Castro is in power. U.S. officials are setting no timetable on Castro's continued rule. But they are betting that he will lose control over the Cuban government from within before another two years.

# Labor This Month

**UNIONS ENTWINE POLITICAL ARMS:** The inter-union hostilities that have divided the AFL-CIO, the Teamsters and the Mine-Mill & Smelter Workers are being forgotten in the warm-up for the national elections. Their political wings—the AFL-CIO's COPE, the Teamsters "drive" and Mine-Mill's political action team—are combining in support of key candidates in some areas. This is duly noted in AFL-CIO headquarters and not objected to, despite disapproval of the two unions otherwise. They are unlikely to combine over a single presidential candidate, but are coordinating in key Congressional, state and local races. For instance, Mine-Mill and COPE jointly back New Mexico Sen. Clinton P. Anderson and Rep. Tom Morris; in Montana, for Senator Lee Metcalf and Paul Cannon for Governor.

**AFL-CIO "STONES" MINE-MILL:** The eight-year rivalry between the AFL-CIO and MMSW in the potash industry may be ended. AFL-CIO headquarters claims "elimination" of the Mine union after an NLRB election victory of its affiliate—the Stone & Allied Workers—at International Minerals & Chemical Corp. The stone workers won a 277 to 160 count over Mine-Mill to represent the potash workers at Carlsbad.

**LABOR-MANAGEMENT TALK TRUCE ANEW:** What must rank as the longest of long-shots, three-man teams from the AFL-CIO and industry are searching a conference formula to ease tensions built up at the bargaining table. Promoted by AFL-CIO chief George Meany and backed by the White House, the aim is a series of industry-by-industry conferences to talk over differences before they reach the bargaining table. A first try last month disclosed no meeting of the minds. Another attempt is coming.

The would-be agenda is impressive. Topics for discussion would include automation, productivity, foreign competition, inflation. Management and labor are miles apart on how to handle such vital issues. But Labor Secretary James Mitchell, who brought them together, believes that an open airing of differences will help clear the air. "They don't have to agree, just talk," he says. Only employers of organized companies are included, but the management team objects to recognizing union leaders as the voice of labor.

**LABOR'S NEW FRINGE IS SHOWING:** The contract settlement scoreboard to mid-1960 reveals a new-type union demand. It's likely to loom large in the future. Unions are now concentrating on the pensioner for contract benefits, this time in the form of health and welfare coverage. A breakthrough came recently in the important Bell Telephone System settlements. Telephone unions won a new "major medical" plan for critical illnesses—with pensioned employees sharing the protection. Top labor negotiator, Arthur J. Goldberg, advises that this is the goal of the future—a contract clause to help protect the retired employee. This will be pushed even if Congress legislates in this area. Though retired union members no longer pay dues, they are carried on the union rolls and are an important asset in backing union political and legislative campaigns. The United Steelworkers tipped the oldster trend in their settlement this year which includes $1,500 for a retiring employee.

**MANAGEMENT RIGHTS—A 1960 BARGAINING THORN:** The biggest trouble spot in current negotiations is over the old subject: Management's right to manage. New disputes frequently center on this as employers aggressively seek more control over the work processes. The 116-day steel strike hung up over this issue. It now centers in critical railroad bargaining and is the basis of other not-so-large negotiations.

Employer prerogatives, as an issue, was revealed too in a recent highly-important election involving an attempt to organize professional engineers. A majority of some 7,000 engineers of the Western Electric Co. rejected an engineers union following a company-union dispute over what constitutes an engineer. The company demanded the right to choose—and label—its engineers. The NLRB agreed, held the election and Western Electric won. It was a defeat for professional organizing.

# MARKETS

## Copper Eases; Lead Sales Good; Zinc Strong in Europe; Aluminum Hearings

PRICES OF NON-FERROUS METALS in the U.S. in May were unchanged from April. The E&MJ index was 125.8% of the 1947-49 average.

**Awareness of over capacity** in the world copper mining and refining industry brought copper prices down outside the U.S. in May.

The E&MJ c.i.f. Europe weighted average price was 32.87c May 4; on the 31st it was 29.995c a lb. The London Metal Exchange quotation dropped for cash bid about 3c and the three months position came down about 1½c.

During most of the period of falling prices the Anaconda El Salvador and Potrerillos properties in Chile were on strike. This indicated partly that persons in the market felt the strikes would not spread.

Officials of many copper companies pointed out in the past month or two that they were prepared to cut output if the market showed over-production persisting. But the point at which the decisions would be made was uncertain. Some indicated they were currently producing at less than full capacity.

Such statements had two effects. They made it clear to buyers that there was too much copper capacity. They also suggested that the producers were not inclined to let copper prices drop to the low levels of two years ago. The former indicated over-supply; the latter an inclination to reduce the over-supply quickly.

But all of this was confused by the political troubles in Africa. Some factors said whoever was boss would see to it that the Katanaga and Rhodesian copper was produced and shipped. But others were less certain, especially about the Belgian Congo. The Government actually owns two-thirds of a company that, in effect, controls the copper mining and refining industry. This control on June 30 will no longer be in European hands. How it will be exercised after that will determine in part the near future of copper markets.

If this uncertainty continues copper producers may be less quick to cut output even if prices weaken more.

**Copper buying in Europe** has been exceptionally good. Total sales reported to E&MJ for calculating the weighted average price were higher in May than for any month in several years. This partly reflected some uncertainty about supply but probably more was the result of the heavy rate at which industry was operating outside the U.S.

Copper buying in the U.S. was slow but producers and custom smelters stayed at 33c. Merchant prices fluctuated but the first of June they were offering at about 32½c.

Brass mills in the U.S. continued at well under capacity. Prices of some of their products had not settled from recent changes. Some U.S. mills had indicated they would end discounts for large lots, at least on pipe and tubing. This would have been a price increase. Comments from persons in the business were that this could not be—imported products were being sold here at lower prices. They also suggested that there was good mark-up already. One large fabricator announced that its base price would apply to lots of 2,000 lb and under, that from 2,000 to 10,000 there would be a 5% discount and over 10,000 lots would go for 8% off. So the discounts may be getting larger.

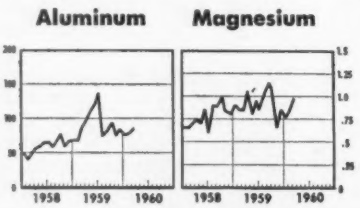
Copper Institute data for April show deliveries outside the U.S. at record rates. Nearly all records for output were broken. Stocks changed little with blister falling about as much as refined rose.

Fabricator stocks moved up about 16,000 tons in the U.S.

**New copper production** facilities may be opened. Kennecott's Charles R. Cox said his company would increase capacity 100,000 tons in Chile if it got the proper guarantees. Anaconda's Brinckerhoff said his company was considering building a 7,500 tpm refinery in Chile and also opening a new 5,000 tpd open pit at El Salvador. Katanaga is reported to have opened a new 50,000 metric ton per year refinery at Luilu in the Congo. This capacity will be doubled in a year. The refinery can also produce 1,750 tons of cobalt.

The manager of the U.S. fabricator association, T. E. Veltfort, told a Commerce Department group that U.S. mill costs are so much higher than those abroad that an increase in exports is not possible "even if foreign tariffs and other restrictions were removed." He advocated limitation of imports into the U.S.

**Zinc pricing** may become more confused. American Metal Climax took ¼c a lb off zinc alloy prices in mid-May. No. 3 is now 16¼c and No. 5 is 16¾c a lb. It indicated there was discounting on these and it had to meet them. Independents said there was very little discounting and that this was by very small "garage plant" operators who had almost always offered discounts in order to get any business. Their low overhead permitted them to sell at about ¼c off. The spread between Special High and alloy 3 is now 1½c. When this happened before pressure was put on zinc producers that did not make alloy to give discounts so that alloy makers could make the 1¾c spread.




Net shipments of aluminum and magnesium mill products in thousands of short tons per month. From U.S. Department of Commerce INDUSTRIAL REPORTS. Latest data for March 1960.

Total zinc sales in May were about 40% over April and higher than March and February. Sellers report their sales to E&MJ for calculating weighted average prices. Buyers had bought heavily in January but were running out of metal.

Zinc Institute data for April showed 71,926 tons shipped. But Special High shipments dropped to 22,797 tons from the first quarter average of 32,270.

Bunker Hill was struck early in May. It produces about 75,000 tons of zinc and about 100,000 of lead. Asarco's Idaho properties were struck later in the month. These may mean enough of a reduction in zinc output to make a difference.

Though zinc demand has not been up to the level of predictions of six months ago, it has not been bad. In about two months buying for 1961 auto die-castings will likely show up at which time the market might strengthen.

Exports of zinc many analysts expect to continue at the 6,000 to 7,000 ton per month level. And at least one large shipper into the U.S. said his quota is not likely to be used up this quarter. Demand abroad has been very good.

**Lead sales reported to E&MJ** for May were about 58,000 tons. This is higher than April and almost as much as Febuary and March together. Shipment figures and sales figures differ considerably—the former usually lag much. In April shipments reported by American Bureau of Metal Statistics were down about 14,000 tons to 30,686.

**Aluminum markets continue slow** in the U.S.

The Congressional Yates Committee heard small fabricators attack the pricing policies of the big integrated producers. The latter were accused of price tactics calculated to squeeze the small independents. General Motors said its new molten metal contract with Alcoa give it metal which in effect is about 4½c under the solid metal price. Die-casters and secondary smelters object to this. They say it is price discrimination and that the cost difference justifies only about ½c under. Primes were also accused of selling to foreign customers at well under their U.S. price. In the hearings it was brought out that 500 tons of this was re-imported and still sold at well under the U.S. price. The primes attempt to prevent such reselling here. The primes said they had to meet the foreign prices which they implied were too low.

# Average Prices May (E&MJ Quotations)

Cents per lb unless otherwise indicated:

| | |
|---|---|
| **Copper:** | |
| Electro, domestic refinery | 32.600 |
| Electrolytic, export refinery | 30.302 |
| Electrolytic, c.i.f. Cont'l ports | 31.247 |
| **Lead:** | |
| Common, New York | 12.000 |
| Common, St. Louis | 11.800 |
| **Silver:** | |
| Silver, New York, per oz | 91.375 |
| Silver, London, pence per oz | 79.335d |
| **Zinc:** | |
| Prime, Western, East St. Louis | 13.000 |
| Prime, Western, delivered (g) | 13.500 |
| **Tin:** | |
| New York Straits | 99.518 |
| **Gold,** per oz, U.S. price | $35.000 |
| **Sterling, Exchange** | 280.601 |
| **Quicksilver, per flask** | $212.000 |
| **Antimony,** (E&MJ) (d) | 32.590 |
| **Antimony,** bulk, Laredo | 29.000 |
| **Antimony,** in cases, Laredo | 29.500 |
| **Antimony** for. 99% | 22.875(h) |
| **Palladium,** troy oz | $24.000 |
| **Platinum,** refined, per oz | 82.000 |
| **Cadmium** (a) | 140.000 |
| **Cadmium** (b) | 150.000 |
| **Al,** 99½% dom., ingot | 28.100 |
| export, pig | 23.250 |
| **Magnesium,** ingot | 35.250 |
| **Nickel,** (f) | 74.000 |
| **Bismuth** | $2.250 |
| **Cobalt** | $1.500 |

Domestic quotations, unless otherwise stated are in cents per lb. Sterling exchange checks, in cents. Quicksilver per flask of 76 lb.
(a) Per lb delivered, ton lots.
(b) Per lb delivered, small lots.
(d) Domestic 5 tons or more but less than carload lots, packed in case f.o.b. New York.
(f) Contract price, f.o.b. Port Colborne U.S. duty included.
(g) Delivered where freight exceeds 0.5c.
(h) 2c duty extra.

# Free Gold Market

International gold dealings in May increased 29% bolstered by Soviet sales of about 50 tons in West Europe. Bar gold and coin prices were generally lower in most centers, rising only in India and Pakistan. London was again the most active market with average daily turnovers of about $2-million. Paris averaged $1.25-million per day in hectic dealings. Gold futures for the first time in two years were not in demand, and premiums of 6 months option listed at less than 4½% p.a. in London and 4% p.a., Zurich. Transactions were limited. Pick's World Currency Report quotes on "free gold" per fine oz. as follows:

| | Coins | | Bars | |
|---|---|---|---|---|
| | Apr. 30 | May 31 | Apr. 30 | May 31 |
| New York transit | ..... | ..... | $35.08⅛ | $35.08⅛ |
| Manila | $39.80 | $39.75 | 35.70 | 35.70 |
| Hong Kong | 48.00 | 47.95 | 38.85 | 38.80 |
| Bombay | 53.75 | 55.50 | 53.00 | 54.00 |
| Beirut | 39.35 | 39.35 | 35.21 | 35.22 |
| Paris | 39.00 | 38.75 | 35.55 | 35.41 |
| Buenos Aires | 40.25 | 38.90 | 35.50 | 35.50 |

Note: Prices are quoted at the free or black market value of the U. S. dollar in the local markets.

# Custom Smelter Copper

Based on flat price and E&MJ average price sales in U.S. for month of May reported by American Smelting & Refining Co. electrolytic copper in standard shapes, adjusted to nearest ⅛c; ¼c deducted for selling common.

| | |
|---|---|
| Delivered consumer's plant | 32.750 lb |
| F. o. b. refinery | 32.350 lb |

# Major Metals

## U.S. DAILY AND AVERAGE PRICES

Cents per lb unless otherwise indicated:

| May 1960 | Electrolytic Copper (a) Domestic | (b) Export | Europe c.i.f. (c) | Lead New York | Lead St. Louis | Zinc (f) Delivered | Zinc East St. Louis | Aluminum 99% Primary U.S. Dest. | Straits Pig Tin New York |
|---|---|---|---|---|---|---|---|---|---|
| 2 | 32.600 | 31.725 | 32.670 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 98.875 |
| 3 | 32.600 | 31.800 | 32.745 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 98.875 |
| 4 | 32.600 | 31.925 | 32.870 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.375 |
| 5 | 32.600 | 31.425 | 32.370 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.250 |
| 6 | 32.600 | 30.600 | 31.545 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.250 |
| 9 | 32.600 | 30.450 | 31.395 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.000 |
| 10 | 32.600 | 30.450 | 31.395 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.125 |
| 11 | 32.600 | 30.550 | 31.495 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.250 |
| 12 | 32.600 | 30.350 | 31.295 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.375 |
| 13 | 32.600 | 30.225 | 31.170 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.625 |
| 16 | 32.600 | 29.725 | 30.670 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.500 |
| 17 | 32.600 | 29.800 | 30.745 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.625 |
| 18 | 32.600 | 29.975 | 30.920 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.875 |
| 19 | 32.600 | 30.275 | 31.220 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.750 |
| 20 | 32.600 | 30.450 | 31.395 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.625 |
| 23 | 32.600 | 30.100 | 31.045 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.625 |
| 24 | 32.600 | 30.275 | 31.220 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.625 |
| 25 | 32.600 | 29.800 | 30.745 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 100.000 |
| 26 | 32.600 | 29.425 | 30.370 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 100.125 |
| 27 | 32.600 | 29.375 | 30.320 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 100.125 |
| 30 | Holiday | 28.900 | 29.845 | | | Holiday | | | |
| 31 | 32.600 | 29.050 | 29.995 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 100.000 |
| **AVERAGES FOR MONTH** | | | | | | | | | |
| May | 32.600 | 30.302 | 31.247 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.518 |
| **AVERAGES FOR WEEK** | | | | | | | | | |
| May | | | | | | | | | |
| 4 | 32.600 | 31.835 | 32.780 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.100 |
| 11 | 32.600 | 30.695 | 31.640 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.175 |
| 18 | 32.600 | 30.015 | 30.960 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.600 |
| 25 | 32.600 | 30.180 | 31.125 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.725 |
| **CALENDAR WEEK AVERAGES** | | | | | | | | | |
| May | | | | | | | | | |
| 6 | 32.600 | 31.495 | 32.440 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.125 |
| 13 | 32.600 | 30.405 | 31.350 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.275 |
| 20 | 32.600 | 30.045 | 30.990 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.675 |
| 27 | 32.600 | 29.795 | 30.740 | 12.000 | 11.800 | 13.500 | 13.000 | 26.000 | 99.900 |

# Silver, Gold and Sterling

## DAILY AND AVERAGE PRICES

| May 1960 | Silver (c) New York | Silver London | Sterling Exchange | Gold (d) London |
|---|---|---|---|---|
| 2 | 91.375 | 79.250d. | 280.8660 | 249s. 11½d. |
| 3 | 91.375 | 79.250d. | 280.9080 | 249s. 11½d. |
| 4 | 91.375 | 79.250d. | 280.8220 | 250s. ½d. |
| 5 | 91.375 | 79.250d. | 280.8300 | 250s. ½d. |
| 6 | 91.375 | 79.250d. | 280.8260 | 250s. ½d. |
| 9 | 91.375 | 79.375d. | 280.7200 | 250s. ½d. |
| 10 | 91.375 | 79.375d. | 280.6860 | 250s. 1½d. |
| 11 | 91.375 | 79.375d. | 280.6280 | 250s. 1½d. |
| 12 | 91.375 | 79.375d. | 280.6660 | 250s. ½d. |
| 13 | 91.375 | 79.375d. | 280.6880 | 250s. ½d. |
| 16 | 91.375 | 79.375d. | 280.5520 | 250s. 1d. |
| 17 | 91.375 | 79.375d. | 280.3466 | 250s. 4d. |
| 18 | 91.375 | 79.375d. | 280.5660 | 250s. 2½d. |
| 19 | 91.375 | 79.375d. | 280.6620 | 250s. 1½d. |
| 20 | 91.375 | 79.375d. | 280.5540 | 250s. 1d. |
| 23 | 91.375 | 79.375d. | 280.4980 | 250s. 2½d. |
| 24 | 91.375 | 79.375d. | 280.4000 | 250s. 3½d. |
| 25 | 91.375 | 79.375d. | 280.3860 | 250s. 4½d. |
| 26 | 91.375 | 79.375d. | 280.4440 | 250s. 3½d. |
| 27 | 91.375 | 79.375d. | 280.3523 | 250s. 3d. |
| 30 | Holiday | 79.250d. | Holiday | 250s. 4d. |
| 31 | 91.375 | 79.250d. | 280.2120 | 250s. 4½d. |
| **AVERAGES FOR MONTH** | | | | |
| May | 91.375 | 79.335d. | 280.601 | — |
| **AVERAGES FOR WEEK** | | | | |
| May | | | | |
| 4 | 91.375 | — | 280.858 | — |
| 11 | 91.375 | — | 280.738 | — |
| 18 | 91.375 | — | 280.564 | — |
| 25 | 91.375 | — | 280.536 | — |

Calendar Week Averages: New York Silver: May 6, 91.375; May 13, 91.375; May 20, 91.375; May 27, 91.375.

THE above quotations for major nonferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis. All prices, except gold and silver, are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered U. S. basis add 0.400c per pound, the average differential for delivery charges.

(b) Export copper daily quotations are weighted averages based on sales outside the U.S. reported to E&MJ. Ocean freight and 0.125c lighterage and handling are deducted to arrive at the f.o.b. Atlantic seaboard refinery quotation. On f.a.s. U.S. sales lighterage of 0.125c is deduced.

(c) The c.i.f. Continental ports quotation is arrived at by adding to the f.o.b. export quotation lighterage, and the standard conference freight and insurance, Atlantic ports to main Continental ports. Currently this is 0.125c and 0.82c.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingots; cathodes are sold at a discount of 0.125c to 0.15c per pound. Quotations for zinc are based on Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East, Middle West and West effective Apr. 1, 1960, commanded a premium of 1.50c per pound over the current market for Prime Western; Special High Grade 1.75c effective Apr. 1, 1960.

(f) Prime Western delivered where freight from E. St. Louis exceeds 0.500c.

Quotations for lead are based on domestic common lead. Corroding lead commands a premium of 10 points (almost all U. S. lead is corroding grade).

(c) The daily silver quotations reported by Handy & Harman, in cents and fractions of a cent per troy ounce, is the price paid by Handy & Harman in settlement for silver contained in unrefined silver-bearing materials submitted to them for refining. It is determined on the basis of offers of bar silver 999 fine as made to Handy & Harman for nearby delivery at New York by regular supplies in quantities sufficient to meet daily requirements, and it is usually 0.250c below the price of which such offers are made.

The Treasury's purchase price of newly mined domestic silver is 90.5c per troy ounce 1000 fine effective July 1, 1946. London silver in pence per troy ounce, basis 999 fine.

(d) U S. Treasury's gold price is $35. Actual payment by the United States Treasury for gold is at 99.75 per cent of the price quoted by the Treasury, which is equal to $34.9125.

# MARKETS *(Continued)*

## London Metal Exchange Quotations

| May 1960 | Copper Cash Bid | Copper Cash Asked | Copper 3 Mon. Bid | Copper 3 Mon. Asked | Lead Current Month Bid | Lead Current Month Asked | Lead 3 Mon. Bid | Lead 3 Mon. Asked | Zinc Current Month Bid | Zinc Current Month Asked | Zinc 3 Mon. Bid | Zinc 3 Mon. Asked | Tin Cash Bid | Tin Cash Asked | Tin 3 Mon. Bid | Tin 3 Mon. Asked |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2 | 258½ | 259 | 246 | 246½ | 76¾ | 77 | 76 | 76¼ | 92⅝ | 92¾ | 90⅜ | 90½ | 783½ | 784 | 778 | 779 |
| 3 | 262 | 263 | 249 | 249½ | 77⅛ | 77⅛ | 76⅛ | 76⅛ | 93⅜ | 93⅝ | 91¼ | 91½ | 785⅛ | 786 | 781 | 782 |
| 4 | 263 | 264 | 249 | 249½ | 77⅛ | 77¼ | 76¼ | 76⅜ | 94 | 94⅛ | 91¾ | 92 | 791 | 792 | 787 | 788 |
| 5 | 258½ | 259 | 246¼ | 246½ | 77¼ | 77⅜ | 76⅜ | 76½ | 94 | 94⅛ | 91¾ | 92 | 791 | 791½ | 787 | 787½ |
| 6 | 249½ | 250 | 242½ | 243 | 77⅝ | 77¾ | 76⅝ | 76⅞ | 92½ | 93 | 91 | 91¼ | 788½ | 789½ | 785 | 785½ |
| 9 | 248 | 249 | 242½ | 243 | 77⅝ | 77¾ | 76⅝ | 76½ | 92½ | 92⅝ | 91 | 91¼ | 786 | 787 | 783½ | 784½ |
| 10 | 250½ | 251 | 244½ | 245 | 77½ | 77⅝ | 76⅝ | 76⅝ | 92¼ | 92½ | 91½ | 91⅝ | 784 | 785 | 783 | 783½ |
| 11 | 249 | 249½ | 243½ | 244 | 77⅝ | 77¾ | 76½ | 76⅝ | 92½ | 92⅝ | 91½ | 91¾ | 786 | 786½ | 784 | 784½ |
| 12 | 249 | 249¼ | 243¼ | 244 | 77⅝ | 77¾ | 76⅝ | 76½ | 91¾ | 92 | 91¾ | 91⅝ | 786½ | 787 | 785½ | 786 |
| 13 | 243 | 243½ | 239½ | 240 | 78¼ | 78½ | 76⅝ | 76⅞ | 91 | 91¼ | 91½ | 91¾ | 784½ | 785 | 784 | 784½ |
| 16 | 242½ | 243 | 239½ | 239¾ | 77⅝ | 77½ | 76½ | 76⅝ | 91¾ | 92 | 91½ | 91⅝ | 783 | 783½ | 782½ | 783 |
| 17 | 244 | 244¼ | 240¼ | 240½ | 77⅝ | 77¾ | 76¾ | 76⅞ | 92 | 92½ | 91⅝ | 91¾ | 785 | 785½ | 784½ | 785 |
| 18 | 248½ | 248¾ | 244½ | 244¾ | 77¾ | 77⅞ | 77 | 77½ | 92 | 92¼ | 91⅞ | 92 | 785½ | 786 | 785½ | 786 |
| 19 | 250 | 250½ | 246½ | 246¾ | 77⅞ | 78 | 77 | 77½ | 92½ | 92¾ | 92½ | 92¼ | 785 | 785½ | 785 | 785½ |
| 20 | 250 | 250½ | 246½ | 246¾ | 78 | 78½ | 77¼ | 77⅝ | 91¾ | 92 | 92 | 92¼ | 785 | 785½ | 785 | 785½ |
| 23 | 247½ | 248 | 245 | 245½ | 78¼ | 78¼ | 77½ | 77¾ | 91½ | 91⅝ | 91⅜ | 92 | 783½ | 784½ | 784 | 784½ |
| 24 | 248 | 248¼ | 245 | 245¼ | 78½ | 78⅝ | 77⅞ | 78 | 91⅝ | 91¾ | 91⅝ | 91⅞ | 781 | 781½ | 782 | 782½ |
| 25 | 240½ | 241 | 239¾ | 240 | 77½ | 77⅝ | 77¼ | 77¼ | 90⅝ | 90⅞ | 91 | 91½ | 782 | 783 | 783 | 783½ |
| 26 | 240½ | 241 | 239½ | 239¾ | 77¼ | 77⅜ | 77¼ | 77¼ | 90⅜ | 90⅞ | 90⅞ | 91 | 783½ | 784 | 783½ | 784 |
| 27 | 237¾ | 238 | 236¾ | 237 | 75⅝ | 75¾ | 76⅛ | 76¼ | 91½ | 91½ | 91 | 91¼ | 782 | 782½ | 783¼ | 784 |
| 30 | 237¾ | 237½ | 236 | 236¼ | 75⅝ | 76 | 76¾ | 77 | 91½ | 91¾ | 90¾ | 90⅞ | 780½ | 781 | 781½ | 782 |
| 31 | 238¼ | 238½ | 236¼ | 237 | 75¾ | 76 | 76¾ | 77 | 91 | 91½ | 90¾ | 90⅞ | 782 | 782½ | 783½ | 784 |
| Av'g's | £248.233 | | £243.011 | | £77.412 | | £76.824 | | £92.097 | | £91.452 | | £785.068 | | £784.000 | |

Prices are for the official a.m. session in pounds sterling per ton of 2240 lb. Copper basis wire bars, lead 99.9%, zinc 98% and tin min. 99.75%.

## Miscellaneous Metals, Ores, Minerals

Quotations cover wholesale lots, prompt shipments, f.o.b. New York unless otherwise stated, tons of 2,000 lb unless otherwise noted. st—short ton; lt—long ton; stu—short ton unit; ltu—long ton unit. (p) duty extra.

### MISCELLANEOUS METALS

May 31, 1960

| | | |
|---|---|---|
| Aluminum ingot, 99 plus % lb | | 28.1c |
| Antimony, spot, lb, less than carload, in cases | | 32.59c |
| In bulk, carload lots, f.o.b. Laredo | | 29.00c |
| Imported, 10 ton min. (p), 99% Duty not paid | 22¾ — | 23c |
| Bismuth, ton lots, lb | | $2.25 |
| Cadmium, ton lots delivered, lb | | $1.40 |
| small lots | | $1.50 |
| Calcium, lb, ton lots, 98%, cast | | $2.05 |
| Chromium, 97% grade, lb, contract delivered | | $1.29 |
| Cobalt, 97 to 99%, per lb effective 3-1-60 | | $1.50 |
| Germanium, per gram, 10,000 gram lots | (d)28.15c—(c)(d) | 29.95c |
| Indium, troy oz | $1.35 — | $2.25 |
| Lithium, lb, 98% | $9.00 — | $11.00 |
| Nickel, cathodes, lb (a) | | 74c |
| Other sales, regular sellers | | 74c |
| Sales by dealers, etc | | 74c |
| Magnesium, 99.8% carloads, lb producer's plants, Velasco, Texas, effective Apr. 16 | | 35¼ |
| Palladium, troy oz | $24 — | $26 |
| Platinum, troy oz | $81 — | $85 |
| Quicksilver, flask of 76 lb, 25 flasks or more | $212 — | $215 |
| Selenium, 99 plus %, lb—(Feb. 19, 1958) | | $7.00 |
| Silicon, minimum 98%, carloads, lb | | 19c |
| Semi Conductor grade, lb | | $360 |
| Tellurium, lb | | $3.50 |
| Thallium, 100 lb or more | | $7.50 |
| Titanium, 99.3% plus, grade A-1, max. 3% Fe, lb (b) | $1.50 — | $1.60 |

(a) Effective Dec. 6, 1956; including U. S. duty; (b) Effective Aug. 1, 1959. (c) Delivered; (d) f.o.b. plant.

### METALLIC ORES

| | | |
|---|---|---|
| Beryllium ore, imported, 10% BeO, (b) stu; spot | $31.75 — | $32.50 |
| term contracts | $34 — | $34.50 |
| Chrome ore per long ton, f.o.b. cars Atlantic ports, dry: | | |
| 44% $Cr_2O_3$ no ratio | (a)$19.75 — | $20.50 |
| 48% $Cr_2O_3$ 3 to 1 ratio | $35¾ — | $38 |
| Iron ore, Lake Superior, Lower Lake ports, lt | | |
| Old Range bessemer | | $11.70(e) |
| Mesabi bessemer | | $11.60(e) |
| Mesabi non bessemer | | $11.45(e) |
| Lead (Galena), 80%, Joplin, Mo., ton | | $141.72 |

Manganese ore—Per ltu of Mn basis 48%, nearby positions, subject to premiums and penalties, c.i.f. U. S. ports import duty extra., (n)87c—90c. Long-term contract nominal.

| | | |
|---|---|---|
| Molybdenum ore, 90%, per lb of Mo f.o.b. mines | | $1.25 |
| Columbium-Tantalum, per lb, combined oxides 10 to 1 ratio | $1.18 — | $1.25 |
| Tungsten ore, per stu of $WO_3$: | | |
| Foreign 60%, c.i.f. U. S. ports, duty extra | $19 — | $19.25 |
| U. S. scheelite, f.o.b. mill | $24 — | $25 |
| Vanadium ore, per lb of contained $V_2O_5$ f.o.b. mines | | 31c |
| Zinc ore, Prime, 60% concentrate, Joplin, Mo., per ton | | $80 |

(a) Nominal. (b) c.i.f. U. S. ports.
(e) Effective 1958 shipping season.

### METALLIC COMPOUNDS

| | | |
|---|---|---|
| Arsenous oxide (arsenic trioxide) lb, in bbl, carload lots N. Y. docks | | 4–5c |
| Cobalt oxide, 72½% to 73½%, per lb, effective Mar. 1, 1960 | $1.13 — | $1.18 |
| Copper sulphate, 100 lb. effective Nov. 6, '59 | | $13.00 |
| Germanium dioxide, gm | | 16½c |
| Molybdic trioxide, technical, per lb of Mo | $1.46 — | $1.47 |
| Imported, including 37c duty | $1.75 — | $2.05 |

### ALLOYS

| | | |
|---|---|---|
| Ferrochrome 65 to 70%, per lb of Cr, (4-9% C) | | 28¾c |
| Ferromanganese, 74 to 76%, per lb shipping point | | 11c |
| Ferromolybdenum, 58 to 64% Mo. lb of Mo contained | $1.50 — | $1.82 |
| Ferrosilicon, 50% per lb of Si f.o.b. shipping point (3-1957) | | 14.60c |
| Ferrotungsten, 72 to 82%, lb of W contained | | $2.15 |
| Ferrovanadium, per lb of V delivered | $3.20 — | $3.40 |
| Silicomanganese, max. 1½% C, lb contracts | | 11.6c |
| Spiegeleisen, per lt, 19—21% grade effective Jan. 22 | $100.00 — | $102.50 |

### NONMETALLIC MINERALS

Asbestos, f.o.b. Canada (Quebec) mines (Canadian funds) ton:

| | | | |
|---|---|---|---|
| Crude No. 1 | $1,400–$1,725 | Paper Stock | $120–$142 |
| Crude No. 2 | $750–$1,100 | Waste | $75– $86 |
| Spinning Fibers | $350– $565 | Shorts | $22– $75 |
| Shingle fibers | $180– $220 | | |

Asbestos, f.o.b., Vancouver, B. C. (Canadian funds):

| | | | |
|---|---|---|---|
| Crude No. 1 | $1,522 | Spinning fibers | $220–$787 |

Asbestos, Vermont, f.o.b. Morrisville:

| | | | |
|---|---|---|---|
| Spinning fibers | $353– $408 | Waste, stucco or plaster | $86 |
| Shingle stock | $181– $218 | | |
| Paper stock | $120– $142 | Refuse or shorts | $41– $75 |

| | | |
|---|---|---|
| Barytes, f.o.b. cars: | | |
| Georgia, crude, per ton | | $18 |
| Missouri, 94%, $BaSO_4$, per st | $16 — | $18 |
| Crude oil well grade, min. 4.3 sp gr, st (a) | | $18 |
| Imported, c.i.f. Gulf Ports, st | $16 — | $18 |
| Bauxite, st, f.o.b. point of shipment: | | |
| Domestic, crude, 50%, 8% Fe, 13% Si | (c)$12.25 — | $13.50 |
| Imported metallurgical, per lt, f.o.b. Br. Guiana, 60% $Al_2O_3$, 6% $SiO_2$, 1.25% Fe, 1–1–60 | | $7.25 |
| Feldspar, bulk ton; f.o.b. plants: | | |
| Potash or soda feldspar, 200 mesh, ceramic grade | $17 — | $20.50 |
| Glass feldspar, white, 20 mesh | | $9 |
| Fluorspar, f.o.b. mines, bulk, 72½% effective, ton | $37 — | $41 |
| 60% effective $CaF_2$ | $33 — | $36 |
| Acid 97% concentrate, bulk, ton | | $45.00 |
| Fuller's earth, f.o.b. Georgia or Florida, ton | $7.00 — | $14.00 |
| Magnesite, per ton dead-burned, bulk, f.o.b. Washington | | $46 |

Mica—Domestic, f.o.b. mines. Punch 7c—12c per lb according to size and quality. Sheet clear 1½x2 in. 70c—$1.10; 2x2 in, $1.10 to $1.60; 2x3 in, $1.60—$2.10; 3x3 in, $1.80—$2.30; 3x4 in, $2.00—$2.60; 3x5 in, $2.60—$3.00; 4x6 in, $2.75—$4.00; 6x8 in, $4.00—$8.00. Wet ground, very fine, $140—$155 per ton, Bulk sales, dry ground; $30—$55 per ton. Scrap $20—$30.

| | | |
|---|---|---|
| Ocher, Georgia, ton in sacks | $26.50 — | $32.00 |
| Sulphur, long ton, U. S. producers' posted quotations* | | |
| f.o.b. mines, bright | | $23.50 |
| dark | | $22.50 |
| f.o.b. vessel, U. S. ports, bright | | $25.00 |
| dark | | $24.00 |

*Prices will vary from these depending on the competitive situation; currently U. S. sulphur sells at close to Mexican export prices.

| | | |
|---|---|---|
| Mexican, for use in Mexico, per metric ton, f.o.b. mines, depending on location | $21.00 — | $23.00 |
| For export f.o.b. vessel, lt, depending on grade | $20.50 — | $22.00 |
| Talc, f.o.b. works, ton: | | |
| New York, purified | $18.00 — | $20.00 |
| Vermont, extra fine | | $12.50 |
| Tripoli, Missouri, ton: | | |
| 40-mesh, cream colored | | $50.00 |

(a) Some restricted sales at $11.50, (b) Corrected. (c) Nominal.

### IRON AND STEEL

| | | |
|---|---|---|
| Pig iron, gross ton, basic, Valley furnaces | | $66.00 |
| Steel, f.o.b. Pittsburgh, billets, net ton | | $80.00 |
| Structural shapes, Pa., Ala., etc., 100 lb | $5.30 — | $5.50 |

B.F.Goodrich

# These B.F.Goodrich tires help haul 200,000 tons of coal a month

THIS unit is one of a fleet that hauls 200,000 tons of coal a month out of a strip mine in Ohio. Ahead is an 8-mile trip to the dump on a road made of shale and crushed rock. Payloads run to 50 tons and over. For this rugged work, the company uses B.F.Goodrich Rock Service tires.

**Now you get even longer service from Rock Service tires, thanks to 2 amazing new B.F.Goodrich compounds.** Only B.F.Goodrich builds tires that are actually *tailor-made* for your type of work.

For jobs where rock cutting and chipping are problems, B.F.Goodrich developed the Cut Protected compound. For jobs with dangerous heat build-up, B.F.Goodrich developed the new Heat Resistant compound. These new tires, and the regular Rock Service, have the B.F.Goodrich FLEX-RITE NYLON cord body that withstands double the impact of ordinary materials. Result: You get more retreadable tires—more retreads per tire.

Get the Rock Service tailor-made for you from your B.F.Goodrich Smileage dealer. He's listed under Tires in the Yellow Pages of your phone book. *The B.F.Goodrich Company, Akron 18, Ohio.*

**Specify B.F.Goodrich Tubeless or tube-type tires when ordering new equipment**

**Smileage!**

# B.F.Goodrich *off-the-road tires*

# "We need the latest, most efficient hauling equipment available . . . we believe that with Haulpak, we have it," says Daniel B. Rengier of J. Robert Bazley, Inc.

"The LeTourneau-Westinghouse 32-ton Haulpak® is the best truck available to handle the hauling of overburden in our strip-mining operations," says Mr. Daniel B. Rengier, Secretary and Purchasing Agent of J. Robert Bazley, Inc., Port Carbon, Pennsylvania, contracting firm. "We need trucks large and rugged enough to handle the big loads of our 8-yd. shovels — yet the trucks have to be fast and maneuverable enough to do it *economically. Haulpaks are the answer!*

### Gives us several extra truck-loads per day

"In order to strip overburden efficiently, the eight-yard shovels must be kept in continuous operation, never held up by trucks that are too small or too slow.

"We estimate that the small turning radius of the Haulpak *gains us several truck loads* in the course of a day by shortening turning time on each trip by as little as 30 seconds. Another time saver is the powerful 375-hp engine. It enables Haulpak to come out of the pit in a higher gear and at a faster rate of speed than any unit we are familiar with. Those pit inclines may be as great as eight per cent.

"Fast turn-around, plus high hauling speeds, mean that each truck can gain *one complete round trip in every seven* — of course we are speaking of trips of average length. Ours vary from 800 to 2500 feet.

### Hydrair* suspension another money saver

"Further savings result from Haulpak's Hydrair suspension system. By leveling the load, it greatly reduces spillage . . . which also cuts road maintenance. In addition, Hydrair increases the life of the tires by distributing the weight of the load *more evenly* over all six tires. Loads on conventional leaf suspension tend to tip and put the weight on only one side of the truck.

### Daily average: 2150 yds per unit

"We estimate that five 32-ton Haulpaks can do the work of seven 22-ton trucks like those we have in our fleet, thereby reducing labor costs as well. According to our records, one Haulpak carries a daily average of 2150 yards of overburden in 14 hours — *thanks to its speed, maneuverability, capacity and power.*

### Saw Haulpaks in action

"We chose Haulpak after a trip by three officials of our company, including myself, to an iron ore mine in Utah to see these units in operation," Mr. Rengier continues. "We were impressed with everything we saw, particularly *the low center of gravity, the very small turning radius and the Hydrair suspension system.*

"The truck's driver demonstrated the effectiveness of this suspension system by rapidly turning the steering wheel from left to right while traveling 24 miles per hour. Ordinarily this type of treatment will start the rear of the truck swinging back and forth, but the Haulpak remained completely stable.

"To bid successfully on contracts for strip mining, we need the latest, most efficient equipment available, and we believe that with Haulpak, *we have it!*"

*We will give you complete information on LW Haulpak — the first all-new truck in a quarter century. Available in 22, 27, and 32-ton sizes. Ask to see our color film, "Revolution on Wheels". You'll see how and why Haulpak moves more tonnage at big savings.*

J. Robert Bazley, Inc., works as many as 200 trucks on its road-building and strip-mine operations, and employs up to 800 men. Its president and founder, J. Robert Bazley, has served as American Consultant to the National Coal Board of Great Britain, to design most of Britain's present day open pit mines. Mr. Bazley's grandfather, Nathan Cuyle, designed and patented one of the first power shovels used in open pit mining. The Haulpaks illustrated here are in use at the Pine Forest stripping operation owned by the Reading Anthracite Company and located near St. Clair, Pennsylvania. J. Robert Bazley, Inc., has run the stripping of this coal mine for about 30 years. This is one of three strip mines it works under contract.

*Trademark HP-2308-DCMJ-2

**LeTOURNEAU-WESTINGHOUSE COMPANY,** PEORIA, ILLINOIS

*A Subsidiary of Westinghouse Air Brake Company*

**Where quality is a habit**

HEAVIER OUTSIDE WIRES mean great resistance to abrasion. FINER INSIDE WIRES mean excellent drum winding characteristics.

In REGULAR LAY ropes the wires are laid in a direction opposite to the lay of the strands. This provides stability even under severe operating conditions.

In LANG LAY ropes the wires and strands are laid in the same direction, providing exceptional flexibility and abrasion resistance.

# Two ropes in one! Roebling Herringbone® Wire Rope is designed and made to wear better, work better, last longer than you can possibly imagine . . . unless you've tried it yourself!

Herringbone combines two pairs of Lang Lay strands with one pair of regular lay strands to give you maximum flexibility, good stability, mighty strength. Call your Roebling Distributor — or write for details to Roebling's Wire Rope Division, Trenton 2, N. J.

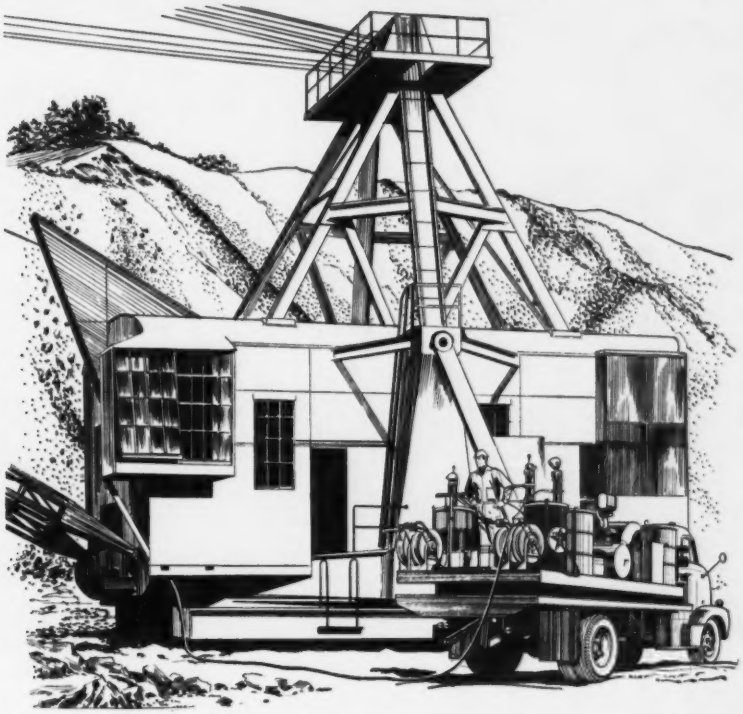
HERRINGBONE WIRE ROPE

**ROEBLING**

*Branch Offices in Principal Cities*
*John A. Roebling's Sons Division*
*The Colorado Fuel and Iron Corporation*

# LUBE LOGIC

## 3 Maintenance Shortcuts



### HOW HIGH IS YOUR HIDDEN COST OF MAINTENANCE?

You may not realize how many extra maintenance dollars you spend when you keep too many lubricants on hand. (Six are usually all you need for all major lubrication.) You pay extra for inventory. You pay extra for storage and handling. It costs you more in paperwork to order. And you'll have to figure the wasted cost of equipment parts and downtime if misapplication should occur.

*The Texaco Lubrication Plan* helps you reduce or even eliminate these hidden costs. That's because it provides the *minimum* number of *proven* multi-purpose and specialty lubricants, tailored to your job requirements.

You'll do yourself a favor when you check with a Texaco Lubrication Engineer. He'll plan your lubrication needs carefully—then follow them up to see that your lubrication problems are taken care of fast.

### THE INSIDE STORY ON OUTSIDE STORAGE

You're short-changing yourself if you skip these simple precautions: Drums stored outside should be placed on their sides. When they are stored on end, expansion and contraction through temperature changes can suck in rain water that collects on top of the drum—*even if the drum has never been opened!*

Want to warm up lubricants that have become stiff from cold? *Don't* use an open flame. This may cause drum leakage or even ruined lubricant. Instead, put the drum inside for awhile before using.

### NEW WAY TO KEEP RUST OUT OF YOUR RADIATOR

Rust in your cooling system can start damaging your engine long before your radiator blows its top. Don't let it start. Some antifreezes—such as Texaco PT Anti-Freeze—will do the job in winter, but in summer you can get protection for pennies with a 1 to 2% solution of Texaco Soluble Oil C.

### TEXACO LUBRICATION ENGINEERS

Every month or so we'll bring you a batch of "sleepers"—little angles, so easy to overlook, where big savings in time and money can be made. But month in, month out, your local Texaco Lubrication Engineer is the best source of money-saving lubrication ideas. Don't forget that "Lubrication is a major factor in cost control."

Texaco Inc., 135 East 42nd St., New York 17, N. Y.

Tune In: Texaco Huntley-Brinkley Report, Mon. Through Fri.-NBC-TV

TEXACO

*Throughout the United States*

*Canada • Latin America • West Africa*

*Michigans help increase production while manpower remains constant. Latest example:*

# 13-ton Tractor Wagon replaces

By replacing three 8-ton dump trucks with one 13-ton Michigan Tractor Wagon, manpower and maintenance expense have been substantially reduced in the stockpiling operation at the Lee Crawford Quarry Co., Cedar Rapids, Iowa.

Lee Crawford, owner-operator of this 250,000 ton per year Florentine limestone quarry and crushing operation, believes in matching equipment to the job. Production has steadily increased since he started "from scratch" 14 years ago, even though for the past 8 years his crew of eight men has remained the same. He has been able to do this by increasing equipment capacity and efficiency.

### Michigan Tractor Shovel replaces swing shovel, portable conveyor

Five years ago his first Michigan machine was purchased . . . a Model 75A Tractor Shovel which replaced both a swing shovel and a portable conveyor. This permitted reassignment of one man for work in another part of the quarry. The unit handles *all truck loading* at the stockpile. It also grades haul roads and unloads equipment from trucks.

The economical and efficient operation of the Tractor Shovel proved so gratifying that when it came time to replace three dump trucks used to haul from crusher to stockpile, Owner Crawford decided to see what else the Michigan line had to offer. He called in Michigan Distributor, Spreitzer Inc., from Cedar Rapids.

### Stopwatch demonstration proves speed and capacity

After discussing his needs, the Distributor brought out a 13-ton Model 110 Tractor Wagon. On a typical cycle, the Michigan loaded 3-inch stone at the crusher bin, traveled 400 ft to the stockpile, made a 90-degree turn, backed 100 ft up a 17 percent adverse grade, unloaded *over the edge* of the stockpile, and returned 500 ft to the bin—all in less than 2 minutes. Average speed for traveling, backing and accelerating was 9½ mph. Similar results were obtained on runs to all four stockpiles.

It was evident that one man and the one Tractor Wagon could do more work than three men with the three dump trucks. This was the kind of production Mr Crawford was looking for. The Michigan stayed. Two of the truck drivers were reassigned jobs in other quarry operations. Thus, manpower in the stockpiling operation was

Michigan, by dumping over edge of bank, eliminates need for dozer cleanup.

During free time from stockpiling, Michigan hauls shot rock.

Big top-opening speeds loading of crushed stone.

Capacity and efficiency of Michigans, as proved by five years experience with this Tractor Shovel, triggered purchase of the 13-ton Tractor Wagon.

# three 8-ton dump trucks

cut by ¾. Maintenance, too, was reduced from three machines to one.

### Stockpiles 2,500 tons per 7½ hour day

Today, a typical 7½ hour shift calls for 24 trips per hour from crusher bins to stockpiles. Distances vary. Maximum round trip cycle is 1400 feet. Average is 600 feet, with good cycle time figured at 1 minute and 20 seconds. Hauling in excess of 13 tons per load, production amounts to about 2,500 tons per day. The Michigan is scheduled to keep all stockpiles at an operating level of 30,000 tons. Normally it can do this and still have time to assist in other areas of the quarry.

### Hauls shot rock, too

Naturally, the 162 hp Model 110 is right at home in the quarry pit too. Here it frequently helps two conventional off-the-road dump trucks haul shot rock to the crusher. It accelerates fast . . . also has the major advantage, because of the rolling action of its big low-pressure tires, of reducing haul road maintenance.

### Truck problems eliminated; so is need for dozer cleanup

"Another major Michigan advantage," says Mr Crawford, "is its ruggedness. Our trucks were being beaten to death on this work. We've had lime piles 50 ft high with grades the trucks just couldn't pull, not to speak of frame distortion and all its complications. This has all been eliminated by changing to the Michigan. Also, the Tractor Wagon's ability to dump over the edge of the stockpile has done away with the part-time need of another machine to push the material over. The Michigan is a good example of what I mean by matching equipment to the job."

### Get all the facts

Like to see how a high-speed rear-dump Michigan Tractor Wagon can be matched to *your* job? Then call your Michigan Distributor for all the facts. He has two model Tractor Wagons to choose from—13 ton and 25 ton capacities.

Michigan is a registered trademark of

**CLARK EQUIPMENT COMPANY**

**Construction Machinery Division**

CLARK EQUIPMENT

2465 Pipestone Road
Benton Harbor 36, Michigan

In Canada:
Canadian Clark, Ltd.
St. Thomas, Ontario

Industry-proved through a quarter century of service... **THERE'S NO DOUBT ABOUT NEOPRENE**

# IS THERE A "WEAK LINK" IN THIS MINING OPERATION?

One of the first places to look is that long, vulnerable length of power cable stretching out from the shovel. It takes a real battering: crushed under tractors, dragged over sharp rocks, exposed to temperature extremes, weather, and sunlight. It takes a really rugged cable jacket to keep electrical service intact under these conditions.

But it is no worry on this job. Reason: the Anaconda cable used is jacketed with tough, durable neoprene. This particular one has been in service at Maumee Collieries' strip mine for over *ten years*.

Neoprene is the *only* cable-jacketing material with records like this to *prove* its ability to protect electrical service under the toughest mining conditions. Neoprene jacketing resists oil and grease, chemicals, heat, cold, abrasion, gouging, impact... and it won't flow under heat or pressure; it is flame resistant as well. There's no doubt about neoprene synthetic rubber. Write for complete facts to E. I. du Pont de Nemours & Co. (Inc.), Elastomer Chemicals Department **EMJ-6,** Wilmington 98, Delaware.

DU PONT NEOPRENE

REG. U. S. PAT. OFF.

**Better Things for Better Living... *through Chemistry***

# 30 MANCHA Storage Battery Locomotives

## Meet All Management Demands and More at Eldorado Operation in Canada

When the Eldorado Company planned its Beaverlodge mine in Saskatchewan, mine management looked carefully at available locomotives. Their basic demands were durability for heavy duty service . . . accessible construction for maintenance work . . . and good protection for the motorman. Mancha's *standard design* met these requirements *and more* . . . large motors for good running speeds and no overheating (glass-wound coils on all motors). Cam-actuated controllers to minimize maintenance . . . heavy duty continuous wound resistance for proper acceleration and longer life. Battery boxes constructed to withstand rugged treatment. In addition, exclusive TRACKMASTER design levels off rough track and gives effective braking action at all times. So Mancha it was — and today fifteen four-ton Titan AN's service development headings and make up main line haulage trains.

The ability to provide low-cost haulage with the 3½-ton Titans was also true of Eldorado's 14 Mancha Little Trammers. These 1½ ton units were used during the initial development of the underground workings. They proved so reliable that they are still in service for supply work and maintenance crews.

Eldorado is another example of how Mancha provided dollar-saving haulage — Mancha can do the same for you.

For longer secondary hauls requiring greater battery capacity, Eldorado uses a Mancha -ton Standard AN.

**MANCHA LOCOMOTIVE**

DIVISION GOODMAN MANUFACTURING COMPANY

Halsted Street and 48th Place • Chicago 9, Illinois
Cable Address: Mancha, Chicago
Mancha representatives are located in principal mining areas throughout the world.

## WESTINGHOUSE PROGRESSIVE AUTOMATION CAN HELP YOU ACHIEVE PLANT FLEXIBILITY, INCREASED POWER EFFICIENCY FOR SMELTING AND REFINING

Changes in electrochemical processing techniques represent the major problem confronting the industry. How to utilize existing facilities when newer production processes are developed . . . and how to optimize profits from the present plant investment are other problems.

Westinghouse is ready to help you plan *economical steps* to automatic production to achieve your goals without over- or under-automating. Westinghouse Progressive Automation is an individualized plan to gain higher product quality through step-by-step control of operations . . . a long-term plan with minimum capitalization.

Rapid growth of the metal mining industry finds many electrical systems badly overloaded without adequate protection . . and narrowly limited in adaptability to changing electrical needs. D-c power requirements in the production of aluminum, copper, magnesium and other metals call for reliable and economical equipment to convert a-c power to d-c power in very large blocks. Powering-Up with an adequate electrical system is a logical first step on the road to Progressive Automation.

To provide more efficient means of supplying the large blocks of direct current, Westinghouse developed the silicon rectifier for all voltages. As compared to other types of rectifiers, the high efficiency of the Westinghouse silicon rectifiers permits power savings of $50,000 in a typical installation rated at 100,000 amps, 300 volts d-c. Recently, Westinghouse installed the world's largest silicon rectifier unit (rated 10,000 amps, 600 volts d-c) for a large aluminum producer.

Automatically regulated furnace transformers, to supply the exacting and varied current and voltage requirements in electrometallurgical and electrochemical operations, are a next step in Progressive Automation. Furnace transformers are subject to frequent short circuits which cause heavy current surges and high mechanical stresses. Westinghouse furnace transformers are designed to handle these conditions and give uninterrupted service.

For drive requirements, reliable Westinghouse motors provide efficient power. Consider the five bonus values of the new F/A Motor: fully accessible . . . inspection is faster, easier and more complete than ever before; inherently quiet . . . housing is isolated from the stator; Thermalastic® insulation . . . for long life and protection of coils; same reliable basic components; easy to connect.

* * *

Westinghouse Progressive Automation is a step-by-step plan toward gaining higher product quality. Carried to its logical conclusion, it can mean eventual coordination of all production variables under a digital computer.

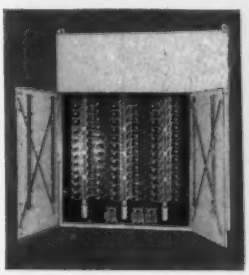
Today, there is one source for all electrical equipment for the metal mining, smelting and refining industries. Call your Westinghouse representative for complete information on PROGRESSIVE AUTOMATION.

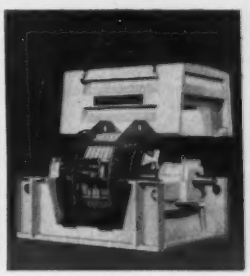
J-96143

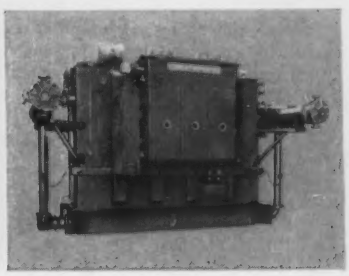
WESTINGHOUSE PROGRESSIVE

AUTO

(Top) Flotation cells, where heavy-duty electrical power is required to constantly mix oil and air with the water and ore. (Lower left) Silicon rectifier unit. (Center) New Westinghouse F/A Motor. (Lower right) Furnace transformer.







AUTOMATION

MATION

YOU CAN BE SURE...IF IT'S Westinghouse

TUNE IN WESTINGHOUSE-CBS TV-RADIO COVERAGE, PRESIDENTIAL CONVENTIONS, JULY 10-29

**Maneuverability for quick spotting** at crusher and under shovel is essential to maintain fast cycle time. Drivers say these big units handle almost as easily as their own cars—particularly like positive brake control on loaded downhill runs.

# Talk about efficiency

## ...four replace nine

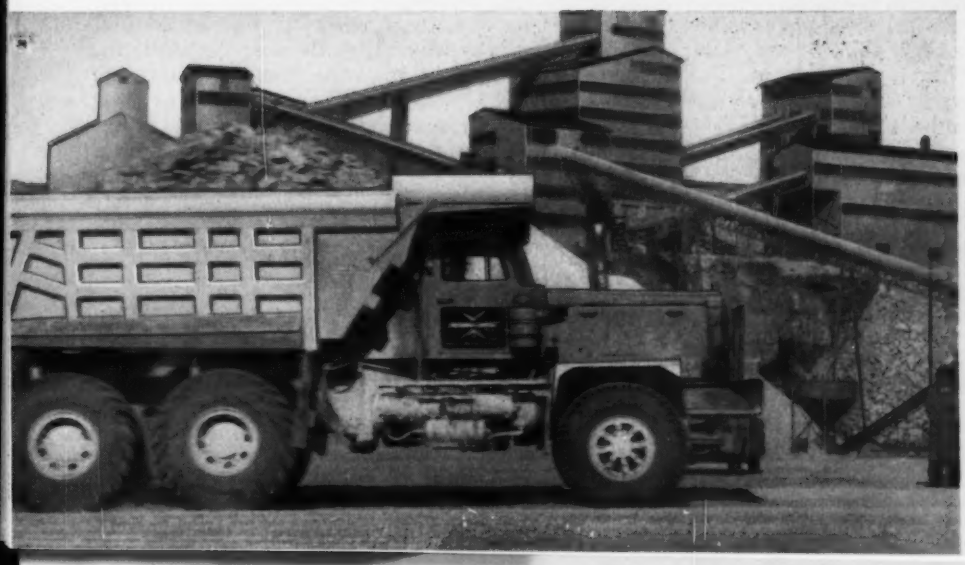
Big tonnage operations like those of Consumers Company, McCook, Ill., division of Vulcan Materials, Inc., depend on modern, efficient equipment to keep operating costs low. In the quarry, fast-action electric shovels pick up 5½-yard bites of shot rock. Four Mack LYSW end-dumpers, working two to a shovel, hustle forty-ton loads three-quarters of a mile to the crusher . . . a total of 288 trips each day. Before Vulcan put the four big Macks on the job, there were actually nine smaller competitive models working under the shovels.

Outstanding performance characteristics enable Macks to contribute to successful quarry and mining operations throughout the world. Plenty of power for fast getaways under full loads. Massive, self-equalizing, air-over-hydraulic brakes and easy, positive power steering for safe, fast maneuverability at shovel and crusher. Traditional Mack construction throughout to reduce downtime and maintenance.

These are sound reasons why Macks are first choice where profitable operations rely on truck performance . . . because they mean that when you purchase a Mack, you get a truck which will outwork and outlive anything in its class—that will pay for itself again and again by delivering top work capability per dollar invested. Your nearby Mack branch or distributor will be very glad to give you full details on the Mack best suited to your operation. Mack Trucks, Inc., Plainfield, New Jersey. Mack Trucks of Canada, Ltd., Toronto, Ontario.

**MACK** FIRST NAME FOR **TRUCKS**

**Fast, modern electric shovels have to hustle** when Mack 40-tonners like these gang up on them. For non-stop production, Vulcan assigns two Macks to each shovel. Exceptional speed and ease of handling are characteristics praised by drivers.



**Big trucks are the profit makers** in quarry operations. LYSW Macks like these easily handle 40-ton loads—hustle 72 trips a day from quarry to crusher—require only routine service and downtime.

## *Surrender Means Victory*
## *. . . with Bethlehem's Yieldable Arch*

No rigid support, however strong, can forever withstand the squeezing pressures of heavy or shifting ground. The best way to control these forces is by "surrendering" a little at a time, allowing the overburden to settle naturally into a pressure arch.

The Yieldable Arch does just that. Each Arch (or Ring) is made up of segmental steel sections, overlapped at the ends as shown in the photograph. Secured around the lapped joints are husky U-bolt clamps, which are drawn up tightly enough to hold fast under normal loads. As pressures bear down, friction in the joints is overcome and the joints yield a little. This "give" transfers the stress to the surrounding material, until gradually, equilibrium is reached. At this point, the Yieldable Arch holds the line, its structural integrity maintained and mine safety preserved. After the area is mined out, you can usually take down the Arch sets and re-use them elsewhere in the mine.

Many installations of Yieldable Arches and Rings have paid for themselves within a matter of months! A Bethlehem engineer would like to discuss the full story in terms of your own special conditions. If you're interested, by all means get in touch with us.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.
*Export Distributor:* Bethlehem Steel Export Corporation

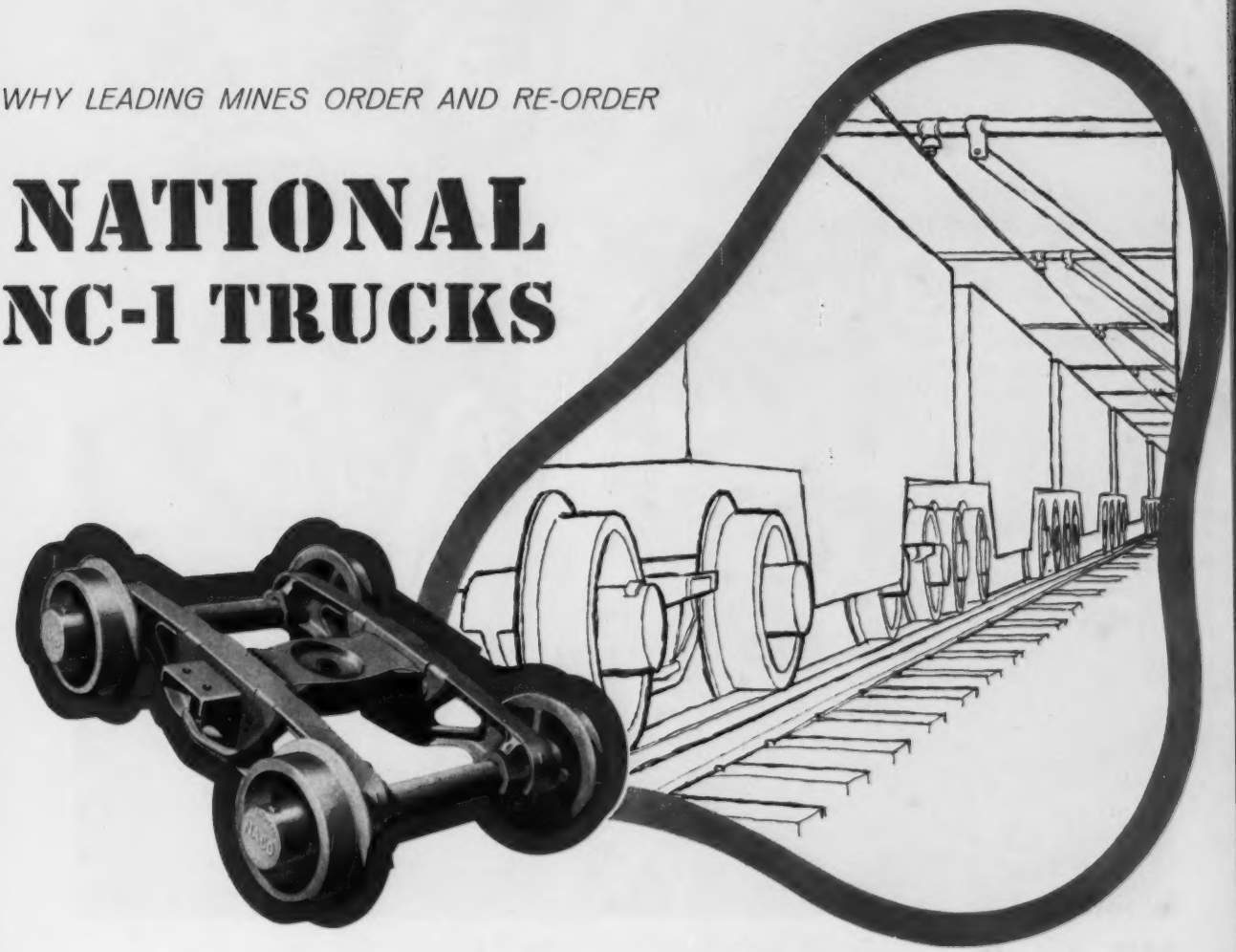
Steel *for Strength . . . Economy . . . Versatility*

**BETHLEHEM STEEL**

BETHLEHEM STEEL

*WHY LEADING MINES ORDER AND RE-ORDER*

# NATIONAL NC-1 TRUCKS



The reasons for the decided swing to National NC-1 Trucks are fundamentally two: they provide safety to personnel and equipment... they make money for mine operators. There are lots of technical reasons, too. Let our representatives tell you all about them.

A-1792A

*Mine Sales • Transportation Products Division*

WILLISON AUTOMATIC COUPLERS
•
RUBBER CUSHIONING DEVICES
•
NACO STEEL WHEELS
•
NACO STEEL LINKS
& SWIVEL HITCHINGS

**NATIONAL**
MALLEABLE AND STEEL
**CASTINGS COMPANY**

*Cleveland 6, Ohio*

# Where heavyweights move job records prove...
# FIRESTONE IS HAUL-ROAD CHAMPION!

Switch to Firestones and hold downtime to a contract-meeting minimum. You can do this because Firestone off-the-highway tires are job-engineered for the toughest projects. There's a Firestone for every need on any project—and every one is built with Firestone Rubber-X, the longest-wearing rubber ever used in Firestone tires. Exclusive Firestone SHOCK-FORTIFIED nylon cord bodies guard against impact damage. And what's more, Firestone's Giant Tire Service backs up every Firestone tire—that means a Firestone Tire Expert will handle all your tire maintenance problems! Turn downtime into worktime—call your Firestone Dealer or Store today.

**ALWAYS SPECIFY FIRESTONE TIRES WHEN ORDERING NEW EQUIPMENT**

Super Rock Grip Wide Base* Super Rock Grip Deep Tread*

**TUBELESS OR TUBED**

**Firestone**

***BETTER RUBBER FROM START TO FINISH***

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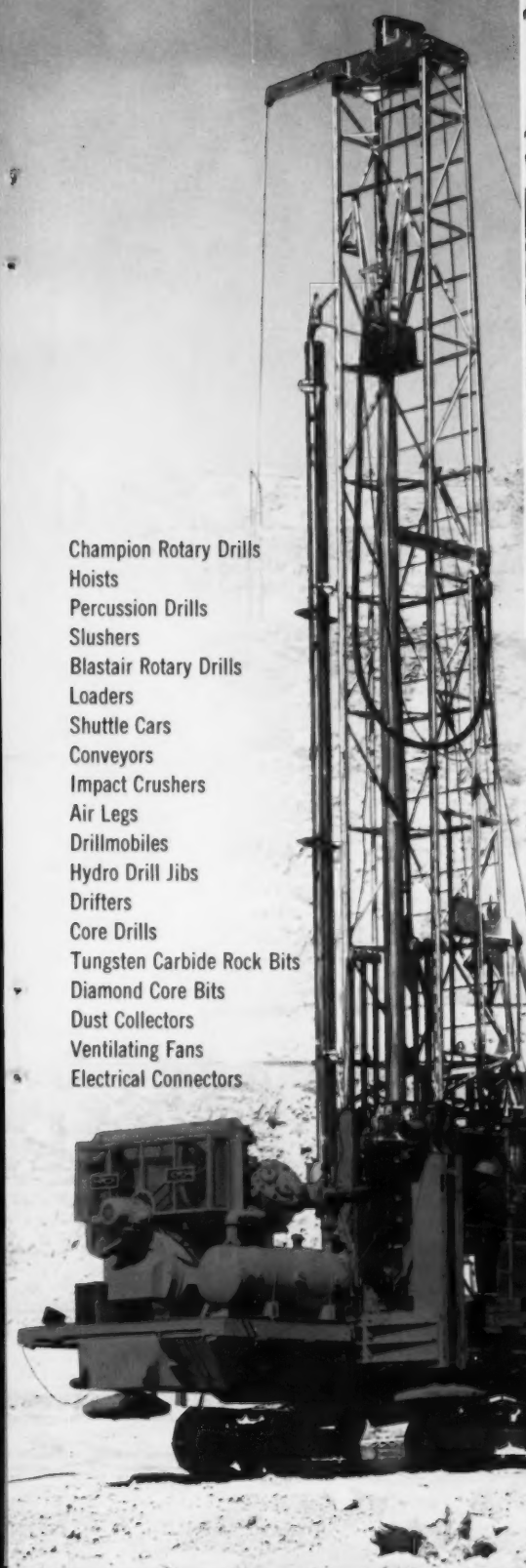
*Firestone T.M.



Champion Rotary Drills
Hoists
Percussion Drills
Slushers
Blastair Rotary Drills
Loaders
Shuttle Cars
Conveyors
Impact Crushers
Air Legs
Drillmobiles
Hydro Drill Jibs
Drifters
Core Drills
Tungsten Carbide Rock Bits
Diamond Core Bits
Dust Collectors
Ventilating Fans
Electrical Connectors

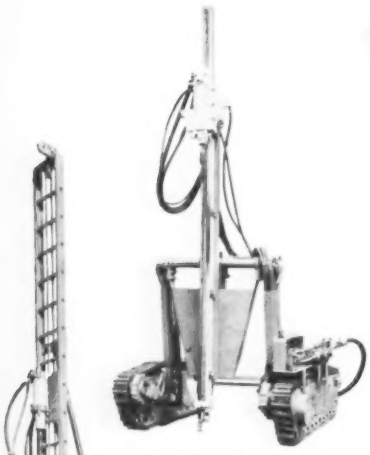
# JOY EQUIPMENT...
# JOY ENGINEERED
## for more profitable mining

**From powerful Joy Champion rotary drills to small hand-held drills weighing 37 pounds, Joy has the world's most complete line of drilling equipment; plus equipment for mucking, loading, hauling, crushing, dust collecting, and ventilating.**

**Whether for underground or open pit, Joy engineers, builds, and services, throughout the world, equipment designed for more profitable mining.**

# World's most complete line of

# DRILLING



TDM Trac-Drill



TWM-5 Challenger Drill

225 Blastair Drill

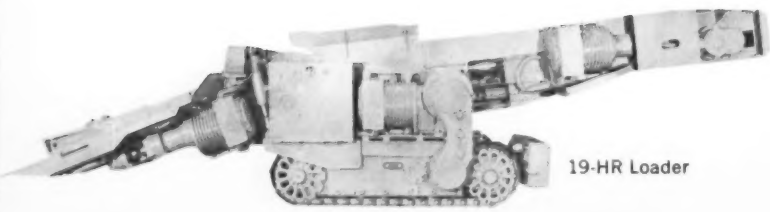
**PERCUSSION DRILLS** . . . Joy Challengers are large-hole percussion drills mounted on self-propelled carriers for 4½" to 6" diameter holes. The 450-DR Dual Rotation drill has an air motor geared to the chuck for boosting normal drilling rotation and for faster steel changes. The TDM Trac-Drill may be equipped with a "U-bar" drill mounting for stability and fast spotting or with a hydraulically operated jib for underground or line drilling.

**CHAMPION DRILLS** . . . a complete line of big crawler mounted rotary blast hole drills with hole sizes from 5⅝" to 12¼". Variable ratio power transmission systems contribute to the faster drilling for which Joy Champions are known. By shifting gears, the operator can select the most favorable relation between torque and rotating speed to get the fastest penetration. Details in bulletin D-39E.

**JOY BLASTAIR DRILLS** . . . are truck mounted rotaries for deep holes of 4¼" to 6¼". For details bulletin RM-703E.

60-BH Champion Drill

## MUCKING



19-HR Loader

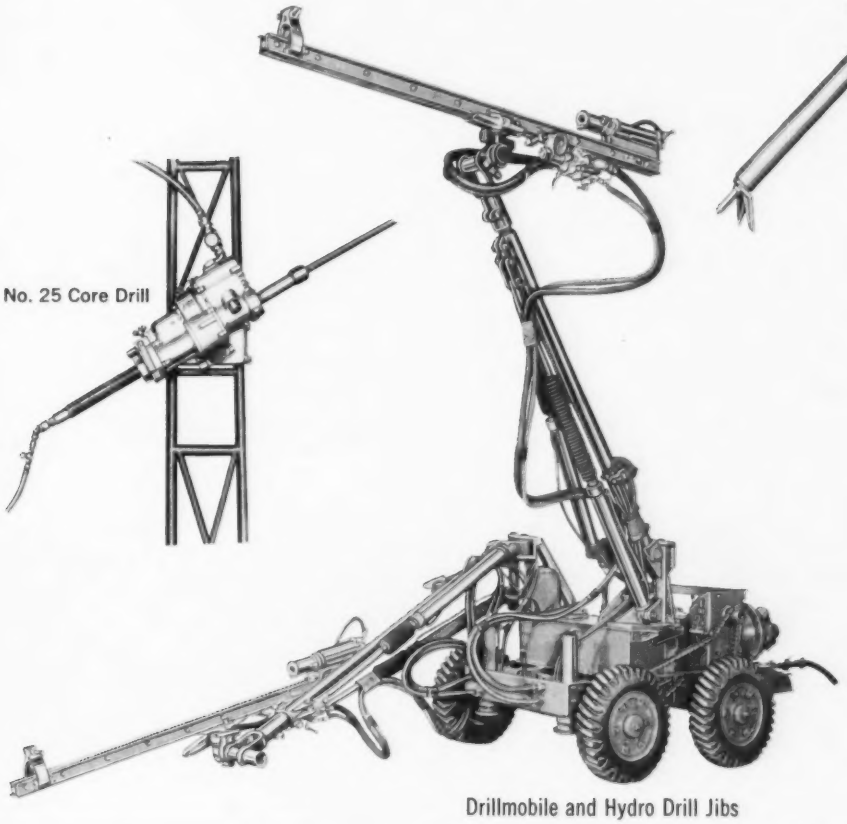
Twin Diesel Shuttle Car

**19-HR LOADER** . . . a rugged, high capacity loader engineered specifically for hard rock mining, the 19-HR has a rated capacity of 20 to 30 tons per minute. Also available is the 18-HR hard rock loader; capacity 10 to 20 tpm.

**TWIN DIESEL SHUTTLE CAR** . . . a new design with an engine on each side of the car to supply power directly. Provides excellent traction and consumes less air than one large engine of equivalent capacity. Haulage capacity of 17 to 20 tons at speeds of 4 to 14 miles per hour. Also available are 60E-12 Diesel Electric car and 14-RC Electric Cable Reel car.

# EQUIPMENT

JAL Air Leg



No. 25 Core Drill

Drillmobile and Hydro Drill Jibs

**AIR LEG** . . . the Joy Air Leg is easy to operate because all controls are grouped at the backhead for one-hand operation. This leaves the other hand free to assist in spotting and collaring holes. Details in bulletin 87-ME.

**HYDRO DRILL JIBS** . . . convert setup time to drilling time with fast positioning of 2¾″ to 4″ bore drifters. All movements of the jib are hydraulically powered and controlled by one operator—jib raise, swing, feed extend, retract, dump, tilt and roll. Hydro Drill Jibs can be mounted on tractors, trucks, mine cars or jumbos. Three models are available. They can also be mounted on the Joy Drillmobile . . . a highly mobile, self-propelled carrier that can be built to suit any underground condition. Details in Bulletin 87-FE.

**CORE DRILLS** . . . Joy diamond core drills for surface or underground exploratory, blasthole or grout hole drilling with skid, column or truck mountings. Also core drilling by contract.

**ROCK BITS** . . . Joy makes a full line of tungsten carbide bits with shoulder, bottom or taper socket drive. Details in bulletin 87-CE.
Also Truco diamond core bits for long life and true, stright holes. For details bulletin D-183E.

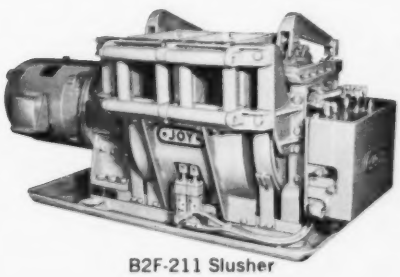
TC Rock Bit

Diamond Core Bit

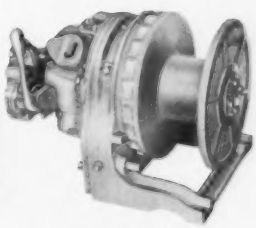
## —LOADING—HAULING

**SLUSHERS** . . . Joy has a complete line of two and three drum slushers with air or electric drive in sizes from 5 to 150 hp. Rope pulls up to 17,700 pounds. Also single drum hoists with air, electric or gasoline motors—rope pulls up to 27,000 pounds. For details bulletin 76-JE (Slushers) and 76-XE (Hoists).

**SHEAVE BLOCKS** . . . a full line of heavy-duty sheave blocks from 6″ to 14″. Quick opening design has no loose parts to become lost. All sizes with open or shrouded side plates. Details in bulletin 76-DE.



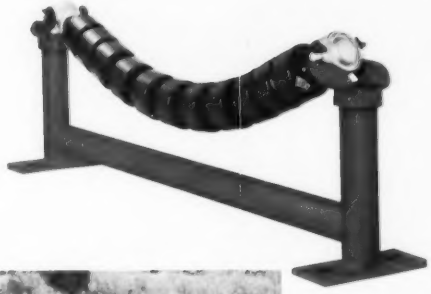

B2F-211 Slusher



DW-111 Hoist

8-FS Sheave Block

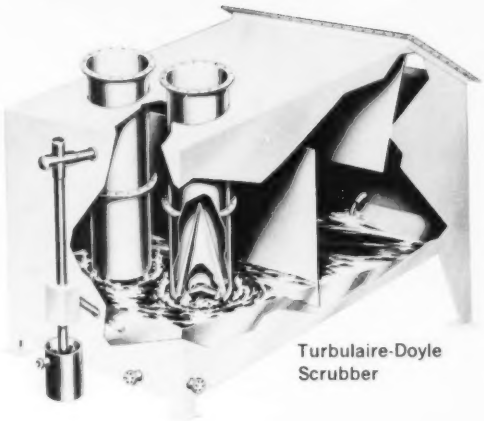
# JOY CONVEYORS
# and Limberoller
# Conveyor Idlers



Limberope Conveyor

Under the difficult service conditions of abrasive ores and heavy impact loading, the Joy Limberoller Conveyor idler gives many times the service life of conventional idlers. The Limberoller is completely flexible. It consists of neoprene discs molded to wire rope which has bearings at either end. Bearings rest in support brackets up out of way of spillage. Constant flexing of the discs makes the entire idler self-cleaning.

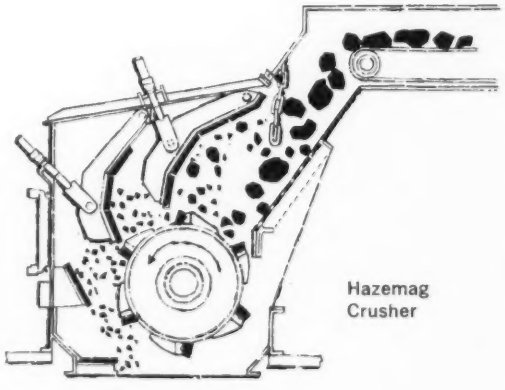
LIMBEROPE CONVEYOR . . . a new type of flexible belt conveyor which can be set up quickly and moved easily. Limberoller idlers are suspended between two wire ropes. The ropes, in turn, are supported by stands which incorporate the return idlers. Since the entire conveyor consists only of stands, wire rope, idlers and belt it can be moved easily or stored in a very small area. For details bulletin LD-105E.



Turbulaire-Doyle Scrubber

DUST COLLECTING EQUIPMENT . . . the Western Precipitation Division of Joy is a full-line producer of all types of dust and fume collecting equipment. Major types include Joy Microdyne Wet Impingement Collectors, Cottrell Electrical Precipitators, Turbulaire-Doyle Scrubbers, Multiclone Mechanical Collectors, CMP Combination Units, Therm-O-Flex High Temperature Dust Collectors and Dualaire Jet-Cleaned Filters. There is no industrial air or gas cleaning problem that Western Precipitation cannot handle with equipment of its own design.

HAZEMAG IMPACT CRUSHERS . . . the Joy Hazemag Impact Crusher provides selective crushing of a wide range of materials with efficiency and economy. By adjusting the position of the impact plates and varying the rotor speed, material is crushed in a controlled spectrum of sizes. For example: limestone for fluxing can be crushed to a maximum grade product in a one-pass reduction to minus ⅛″ plus 100 mesh. Hard and soft parts of congomerate can be crushed to different sizes in one pass, for recovery of mineral values in one fraction by a scalping screen. Twenty models available with capacities from 5 to 500 tons per hour. For details bulletin MD-101E.



Hazemag Crusher

## JOY MANUFACTURING COMPANY

333 Oliver Bldg. • Pittsburgh, Pa.

*Offices in All Principal Cities*

Litho in U.S.A. 1949

Bulletin M-223 5M—5060-0

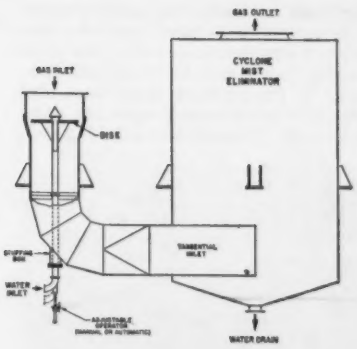
B2F-211 Slusher

DW-111 Hoist

8-FS Sheave Block

Diamond Core Bit

# NEW PRODUCTS DIGEST




## Modified Scrubber (26)

NEW TYPE SCRUBBER using a unique adjustable flooded disk has been developed by Research-Cottrell Inc. for high efficiency gas fume cleaning.

"Major feature of the unusual new scrubber," R-C said, "is its ability to adjust to a complete range of operating conditions. At gas flows 50% higher or lower than normal, water rates and pressure drop remain the same while gas cleaning efficiency is maintained at a high level.

Key feature of the flooded disk scrubber is a turbulent flow of gas-liquid mixture that provides an intimate and violent contact between dust and liquid particles. Water or other scrubbing liquid enters through the stem of the disk support and is injected into the gas duct at the center of the disk. Here the water breaks up into millions of extremely fine particles which collide and adhere to the dust fume.

Pressure drop through the flooded disk scrubber can be kept constant at all gas flows from 50% to 150% of rated conditions. At high gas flows, blowing system equipment is not burdened with an extra power load at the wrong time.

Large water passages in the new scrubber make it possible to operate effectively with very dirty water. With no restrictions or nozzles to plug up, maintenance and replacement downtime are negligible on the flooded disk system. Water can be constantly recirculated through the system and the effluent volume sharply reduced. This makes it possible to reduce the size and cost of effluent treatment equipment.

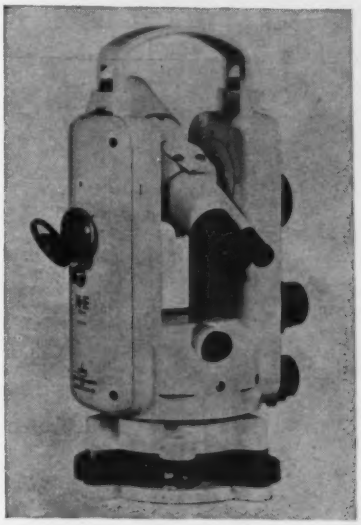
Flooded disk design eliminates long converging and diverging flues. Compact and easy to operate, the new scrubber takes up a minimum of plant space. Areas subject to abrasion are limited to the disk and cone, and only small amounts of abrasion-resistant materials are needed.

## New Theodolites (25)

KEUFFEL & ESSER CO. has introduced a new line of theodolites designed for American and Canadian operations.

The three new models (KE-1, KE-2 and KE-6) are, the company stated, the result of extensive research including a two-year survey to determine design features preferred by North American engineers.

Exclusive features of the new models are: erected image—conforming to American transits; built-in pendulum system that enables automatic indexing of the vertical circle; all control knobs are on one side; unique leveling head joint system gives instrument a permanently rigid base; fully interchangeable accessories, designed to work with all K&E theodolites; and they're all equipped with internal lighting.

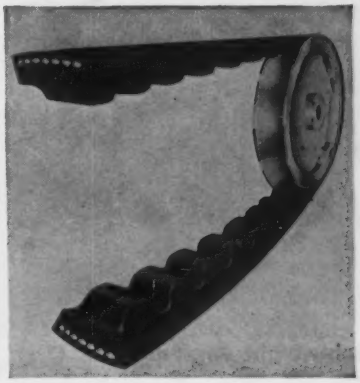


The KE-6 can be read to one minute with interpolation to six seconds, while the KE-2 gives direct reading to one second, and can be interpolated to 0.1 second.

## Truck-Mounted Drill (6)

ONE PARMANCO TRUCK-MOUNTED DRILL (Paris Mfg. Co.) is now able to be used for three operations—auger boring, core drilling and soil sampling.

The F-100 has an off-the-hole hydraulic sliding base which retracts 18 in. without the truck being moved, hydraulic operated leveling jacks, and centralized controls—all within easy reach of the operator.



## Notched V-Belt (5)

RAYBESTOS-MANHATTAN INC. has developed a fully molded, fully jacketed notched V-belt, which they say is the only one of its kind.

R-M calls it the "CX" V-belt and states that it has the following advantages: quiet and vibrationless, rugged, greater flexibility, greatly increased fatigue resistance, resists cross-sectional distortion; and, according to performance tests, the belt will outlast other belts by as much as eight to one.

The company went on to say that the belt's high-tensile-strength members are micro-positioned and formed into an arch—results in increased sidewall pressure, providing more grip, little or no spillage, and more uniform pitch.

## Preview—the Microprobe

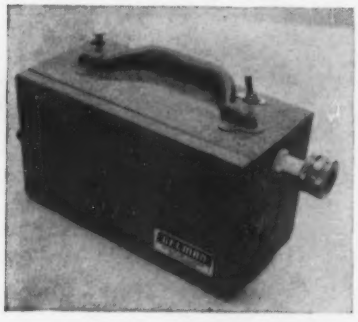
A PROBE USED FOR MICRO-STUDIES of minerals and one which can get a chemical analysis accurate to a fraction of 1% has been built by Stanford University's Metallurgical Engineering Dept. (It's one of about a dozen in the U.S.)

The microprobe shoots a tiny stream of electrons (about 1/1000 mm in dia) and penetrates the polished surface of the unknown metal to a depth of one micron.

Here's how it works. The electrons are focussed by magnetic lenses to form an ultra-thin "finger" which bombards atoms in the metal sample. Some of the energy lost by electrons in the bombardment is transformed into X-rays. These spray out in all directions from the sample's atoms. When observed with spectrographic equipment, they show the characteristic X-ray diffraction pattern of whatever element happens to be present in the sample.

Stanford's Prof. Victor G. Macres, the probe's builder, said that it has strong

potentials in a number of uses: it can determine the alignment of crystals in a substance, or even act as the catalyst in micro-chemical reactions; and it can be used with a cathode ray tube and its beam will scan the entire sample to produce either a complete electron micrograph or an X-ray micrograph. Still other potentials are being explored, Professor Macres said.



### Lightweight Air Sampler (7)

NEW AIR SAMPLER, which weighs only 9 lb and samples 2 cu ft per minute, has been developed by Gelman Instrument Co.

The instrument's centrifugal vane pump unit never needs lubrication, and a built-in fan and louvered metal case provide enough air circulation to keep it cool.

Gelman said that its Bantam Sampler is designed for hard use; the case protects it from rough handling and accidental dropping. They went on to say that the flowmeter is directly calibrated in liters per minute, and that the sampler is supplied with a 1-in. open filter holder which can easily be connected to the pump by a new polyethylene press fit coupling.

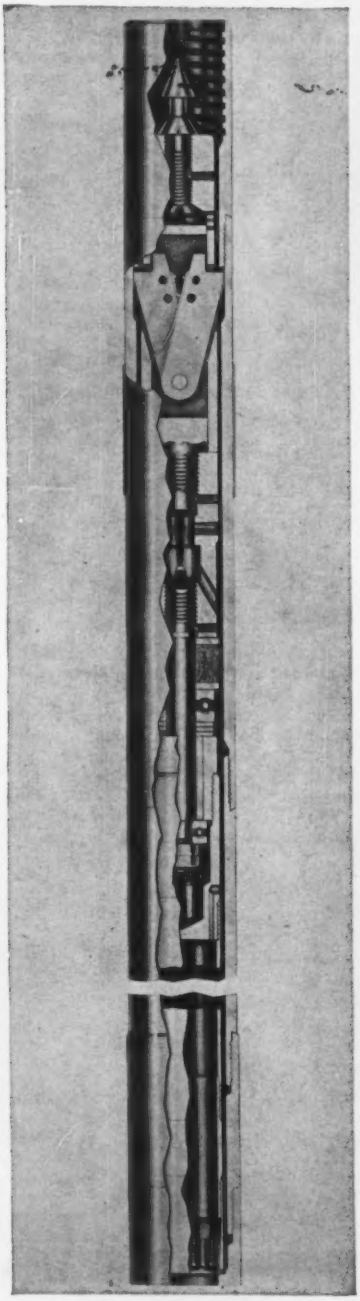
Bantam Sampler is available for 110 v a.c., 6, 12 and 24 v d.c. operation. (It's also available in European voltages.)

### Improved Cutting Torch (8)

NATURAL GAS HAND CUTTING TORCH which has the largest gas flow and the widest cutting range of any now existing, and which can slice through 30-in. of metal in a single pass, has been introduced by Union Carbide Corp.'s Linde Co.

The new torch, Oxweld C-66, has interchangeable injectors which make it possible to use with either low- or medium-pressure natural gas. Linde also said that the spring-loaded injector assembly provides uniform and thorough mixing of gases and eliminates flashback.

According to Linde, all types of cutting jobs can be handled faster and easier with the C-66 because of its tremendous preheat capacity and large cutting oxygen flows. It is ideal for removing large risers.



### Core Barrels (24)

NEW SERIES of Wire Line core barrels (Series 10) recovers cores up to 25% larger in diameter, according to E. J. Longyear Co.

Longyear said the new Series 10 barrels increase core size to $^{15}/_{16}$, $1^{5}/_{16}$ and $1^{23}/_{32}$ in. for AX, BX and NX Wire Line barrels respectively, but drill the same size holes as the corresponding designs.

Narrower kerfs used with the new Wire Line barrels reduce the carat weight of diamonds by 10 to 20% compared to the previous wider kerfs, and also help to increase penetration speed and bit life. (Drawing shows the NX size.)

### 24-in. Ripper (23)

GREENVILLE STEEL CAR CO. is introducing a ripper equipped with 24-in. penetration curved shanks made to fit on the rear of International Harvester's Drott K-3 crawler. Shanks and tool beam have sufficient clearance to permit the K-3 to tow other equipment.

According to Greenville, pitch and depth controls permit the operator to place and hold points at best ripping depth to the 24-in. maximum. Shanks swivel 15° in either direction.

The 102-in. wide tool beam is of reinforced, box-type construction equipped with bearing surfaces where swing brackets are attached.

### Mine Roof Mat (12)

A MINE ROOF BOLT MAT that's light, easy to install and designed specifically to prevent rock spalling conditions, has been developed by Commercial Shearing & Stamping Co.

The 13x108-in. mat has corrugated edges to provide proper rigidity for sub-

stantial support, but at the same time it is flexible enough to conform to the mine's roughest contours.

Number of bolts used with the mat varies with the existing ground conditions, but seldom do conditions require more than three bolts—one at each end and one in the center.

The 9-ft plate has an area of 9.75 sq ft, and weighs 30.6 lb in 14 gage and 23.7 lb in 16 gage.

### Improved Pocket Radio (19)

ALL-TRANSISTORIZED shirt-pocket personal radio communications receiver that has 35% less battery power but more audio efficiency than previous hand-carried message equipment, is being introduced by General Electric Co.

The new model, called "Voice Director," is engineered so the person wearing it may be contacted instantly by a base station transmitter, a two-way radio in a car, or by a portable unit operating on the same frequency. It weighs only 12 oz with battery. When on standby,

ready to receive a call, Voice Director uses only 32.5 milliwatts as compared with more than 50 milliwatts for the earlier types. While a message is being received, the power drain is 58.5 milliwatts, one-sixth the drain of previous units.

Another feature of the new receiver that helps cut down power requirement and energy storage is a ferrite loop-stick antenna. This is built in the receiver's case in the space gained by using the smaller battery—no need for an externally-mounted antenna.

### Welding Flux (13)

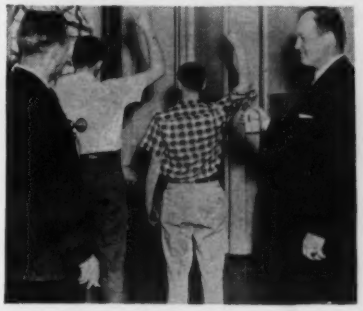
A INERT WELDING FLUX, specially developed for use with automatic submerged arc hardsurfacing wires, is being introduced by Hobart Bros. Co.

When using the flux, hardness, ductility and work hardening characteristics of the weld metal will be determined solely by the alloying content of the wires.

### Hand-Held Safety Horn (17)

A SMALL, HAND-HELD SIGNALING HORN, capable of being heard above the loudest industrial noises and even by persons with severe hearing defects, is being manufactured by the Falcon Alarm Co.

Recently, at the Maryland School for the Deaf, a Falcon signal went off and several of the students reacted. Lloyd A. Ambrosen, headmaster of the school, explained that the totally deaf students didn't actually "hear" the horns in the auditory sense. "They feel the sound in a kinesthetic sense," he said. "Although in



cases where hearing is not completely gone, the reaction is based on a combination of kinesthetic and auditory response."

Falcon's hand-held safety signaler gives up to 300 loud, long-range blasts from its disposable 15-oz Aerosol-type power container.

### Hand-Pumped Force Multiplier for Mine Caves (36)

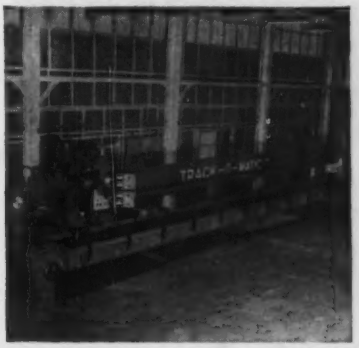
HERE'S A NEW product that, though demonstrated on automobiles, can have great application in both surface and underground operations. It's an easily-handled, hydraulic pump which has a ram that "multiplies" hand action and transmits it through a long flexible hose to a special attachment that can lift, pull or push.

At a recent demonstration, the Porto-Power (made by Mine Safety Appliances Co.) exerted tremendous force on the door of a smashed automobile to safely get to the pinned "victim." Mine Safety said that forces could range from four tons for light duty to 10 and 20 tons for heavy duty.

### Template Positioner (14)

AUTOMATIC WELDING CO. recently announced the development of a new Automatic-Set Template positioner attachment on their Twin Track-O-Matic welding unit which they said will reduce the time required in this operation by up to 80%.

The new "Electro-Set" positioner automatically drops the templates in close-



tolerance position as it passes over the track secured on the welding table.

AW said that the operation takes an average of 5 to 8 minutes per rail, and achieves greater accuracy and assures a better finished job—possibility of human error has been eliminated. The complete positioner unit swings up and out of the way during the welding operation.

### New Tractor-Shovel (20)

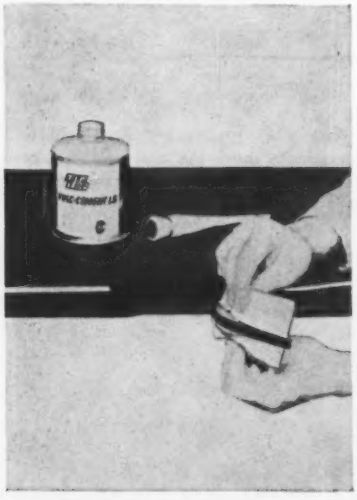
ENTIRELY NEW tractor-shovel (Model H-30) of a size and type never before available in the "PAYLOADER" line, has been put on the market by the Frank G. Hough Co.

The H-30 has an operating capacity of

3,000 lb and is equipped with a one cu yd bucket. Its four-wheel-drive has power-shift "PAYLOADER" transmission with matched torque-converter — with three speed ranges in each direction, all shifts can be made "on-the-go" with no need for range shifts.

Hough said that the 8.3-ft clearance under the cutting edge (with bucket in dumped position) and the 29-in. dumping reach ahead of the front tires, are even greater than on some larger machines.

H-30's parts have been designed to be easily accessible. Both fuel tank and transmission can be checked and filled from ground level, and a quick-opening compartment on the left side of the machine gives easy access to battery and instrument connections.



## Belt Cuffs (21)

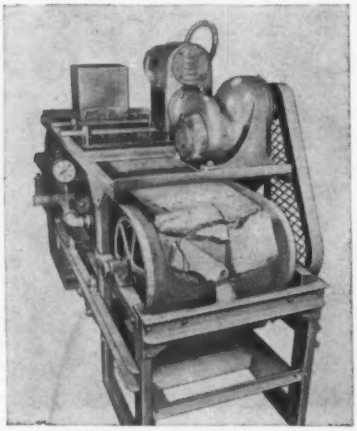
CONVEYOR BELT EDGES can now be repaired on the spot without the use of costly or heavy equipment, according to Rema-Tech Inc. The company said that its product, preformed edge repair cuffs, are the latest cold vulcanized repair materials for damaged or frayed conveyor belt edges.

Main advantages of the cuff are that the repairs are of high quality and that they can be done both quickly and easily.

## Vacuum Filter (16)

NEW HORIZONTAL, continuous vacuum filter, manufactured by Straight Line Filters Inc., uses an entirely new type vacuum seal with no movable valves, and has a corrosion resistant, sectionalized drainage belt to permit close separation of filtrates.

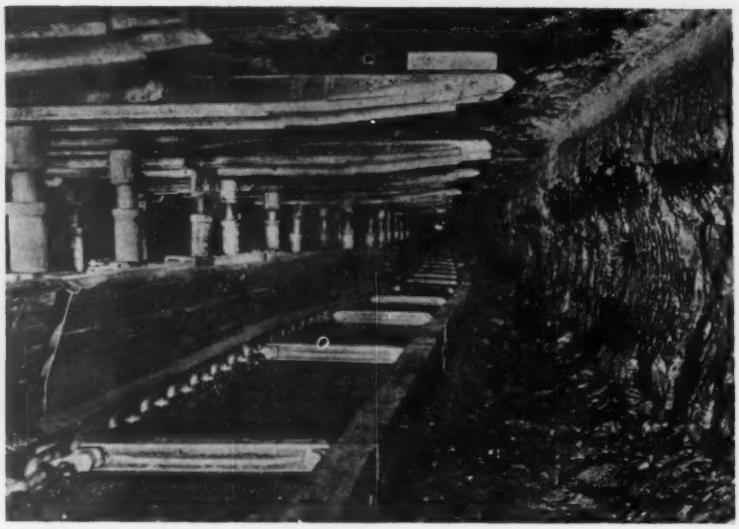
Some of the features of the Straight Line filter are: low operating and maintenance costs, less headroom and floorspace than filters of equal capacity, and the entire filtration cycle from feed to filter cake discharge is visible at all times—assuring maximum operating efficiency.



## Diesel Lube Oil (9)

A NEW LUBRICATING OIL, Super "RPM DELO" Special, developed especially to upgrade the performance of diesel and heavy duty gasoline engines, has been introduced by Standard Oil Co. of California.

The new oil is far ahead of diesel engine design, Standard said, because it is fortified with special detergent-action additives, corrosion and oxidation inhibitors and an effective defoaming agent. It



## British Roof Support Resets in Seconds (35)

THE DOWTY ROOFMASTER MINE SUPPORT, first introduced into British coal mines in 1954, is, according to Dowty Group Ltd., a system of self-advancing hydraulic powered support for fully mechanized longwall mining.

Parts for the Roofmaster units are all standardized, and the supports can be quickly dismantled for maintenance purposes. "Operation of the units is extremely rapid," Dowty said, "with a support released, advanced and reset in a matter of seconds. Only two men are needed for roof control.

## Improved Surveying Tool (10)

GEODIMETER CO. HAS JUST DEVELOPED an improved surveying instrument for electronically measuring distance. They call it the Model 4a and claim that it has the following advantages: improved readability, 25% reduction in pointing time (has an enclosed coarse pointing sight), can be used in extremely cold weather (contains a Kerr cell heater), and has a holder for spare projection lamps built into the body of the instrument.

# For Your Files

**This selected manufacturer's literature is free unless otherwise specified. If item is for sale, send request and money direct to manufacturer.**

**EXHAUST PURIFIERS** for oxidizing carbon monoxide, fumes and odors from gasoline, LP-gas and diesel-powered equipment are described in a four-page folder from Oxy-Catalyst Inc.

The folder, "For Cleaner Safer Air," states that the OCM Catalytic Exhaust Purifier eliminates 95% or more of carbon monoxide and over 80% of the other objectionable exhaust elements. **(70)**

**COMPLETELY REVISED** and up-dated booklet (Adv. 1124) on chromium-nickel types of stainless steel has been issued by Republic Steel. It contains, says Republic, sufficient general information and technical data to enable users of stainless to make correct design and buying decisions. **(71)**

**FOUR-COLOR BULLETIN** (3,000) describing the power, speed and handling characteristics of six Michigan line tractor shovels has been published by the Construction Machinery Div., Clark Equipment Co. **(72)**

**FOUR SIZES** of first aid kits—presented in all-weather cases designed to hold unit-size packages of dressing or treatment—are described in Bulletin 0401-10 available from Mine Safety Appliances Co. **(73)**

**BARBER-GREENE's** new "Redi-Fab" belt conveyor line is described in a 20-page catalog. B-G said that their new line is fully standardized; offers off-the-shelf deliveries of components from stock; has new, improved drives; has a complete selection of accessories; and is easily altered to meet changing installation conditions. **(74)**

**TWO LARGEST** capacity "Michigan" tractor shovels (Models 275A and 375A) are presented in a four-color Bulletin TS2500 from the Construction Machinery Div., Clark Equipment Co.

Both tractor shovels are designed for extra heavy-duty digging and loading jobs, and for operations where high materials handling output is essential—275A is equipped with a 4½-yd bucket and the 335hp 375A has a 6-yd bucket. **(76)**

**LINK-BELT CO.** has introduced a completely new line of fan-cooled worm gear speed reducers available in 25 types and over 135 different sizes. Ratios range from 5:1 to 3600:1, with torque ratings up to 135,000 lb in. and hp ratings up to 150. They're all described and illustrated in the company's 66-page book 2824. **(77)**

**THE CONTRACTING-ENGINEERING** firm, Intrusion-Prepakt Inc., has prepared an up-to-date, definitive survey of dewatering and grouting operations and is releasing this information in their Special Report No. 104. Some of the chapter headings include: Sealing and Sinking Two Shafts at Southwest Potash; Grouting in Gold Mine Air Shaft; Water Control at Iron River; and Dewatering a Mine Shaft with Prepakt Plugs and Intrusion Grouting. **(78)**

**FLEXHAUST CO.'s** 24-page Bulletin 92 gives a complete rundown on applications and specifications of their flexible hoses used in air and materials handling, dust collection and fume control. **(79)**

**EUCLID DIV.,** General Motors Corp., has just published a 24-page report (Form No. 608) on a year-long demonstration of Model C-6 tractors. Well-illustrated with working views, the booklet describes the types of operations where the 211 net hp tractor was used. **(80)**

**PRODUCTION** and mechanical advantages of the new Caterpillar D7, D6 and D4 tractors are discussed in "The Profit Side of Your Ledger," a new eight-page booklet (Form D004) from Caterpillar Tractor Co. **(81)**

**McLANAHAN & STONE CORP.'s** two-stage Triple Roll Crusher is detailed in a new four-page bulletin. The unit reduces feed to sizes as small as ½ in. in a single pass. **(82)**

**UP-TO-DATE SUMMARY** of the forms, properties and applications of Dow Corning silicones is contained in a new 16-page brochure (1-115). **(83)**

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This unretouched photograph shows a multiple hole blast detonated with Primacord, and hooked up with Primacord M/S Connectors in the trunk line. Note the steady progress of this blast from the point of initiation at the left as indicated by the red line.

## Millisecond Delay Blasting with Primacord and

# PRIMACORD M/S CONNECTORS

## can provide you with these 8 advantages:

One of the primary purposes of millisecond delay is to provide relief between holes or rows of holes. When properly relieved, each succeeding charge "takes the line of least resistance." This condition usually results in

1. Less explosive required than for comparable instantaneous blasting.
2. Better fragmentation.
3. Less vibration and concussion.
4. Better control of throw or displacement.
5. Reduction of "toe" and undesirable backbreak.

Primacord will initiate all cap-sensitive explosives, but is insensitive to detonation by stray electrical currents, sparks or ordinary shock. When Primacord is used for all in-hole priming and to connect all holes, you have these additional advantages:

6. The work of loading the blast can follow the drillers. The holes can stand loaded and Primacord primed until everything is ready for the blast.
7. Danger of a premature blast is minimized. You detonate the Primacord trunk line with fuse and cap or electric blasting cap attached *only when all is ready for the blast.*
8. Less chance of missed holes with unexploded powder and caps in the muck.

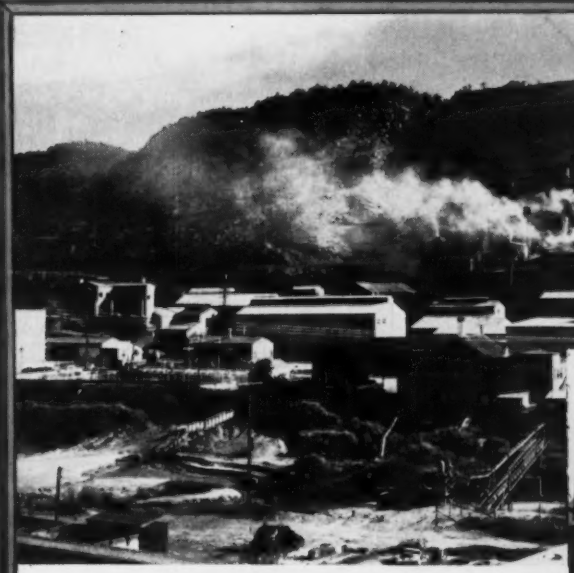
The Primacord M/S Connector is a non-electric delay device. It consists of a metal tube containing a delay element in the center with a series of adjacent charges at each end. A piece of Primacord about 12" long is crimped onto each end of the metal tube. The Primacord M/S Connector is constructed symmetrically about the center and therefore functions in either direction. The Connectors are used by simply cutting the Primacord trunk line at the spot where the delay is desired and tying the Connector to the cut end of the Primacord trunk line with a square knot. Primacord M/S Connectors may be obtained for three different delay periods: 5, 9 and 17 milliseconds. They are packed 50 in a cardboard tube, 500 to a case. Manufactured by E. I. duPont de Nemours & Company. Available through all explosives suppliers.

# The ENSIGN-BICKFORD COMPANY

**Simsbury, Connecticut • Since 1836**

MS-2

# FAME



**LARGE URANIUM PRODUCER picks dozens of "U.S." Belts for a dozen different uses**

Union Carbide's plant at Uraven, Colorado, one of the nation's biggest uranium processing plants, operates on a 3-shift, 7-day-a-week basis. U.S. Rubber Conveyor Belts play a vital part in its operation.

This has been true from the very start of the operation. For example, when a large addition to the plant was completed, U.S. Rubber supplied 16 new conveyor belts. With this addition, more than three dozen "U.S." Belts now help carry the vital tonnage through the various phases of uranium processing.

One U.S. Giant® belt handling hot materials has *outlasted previous belts four to five times.*

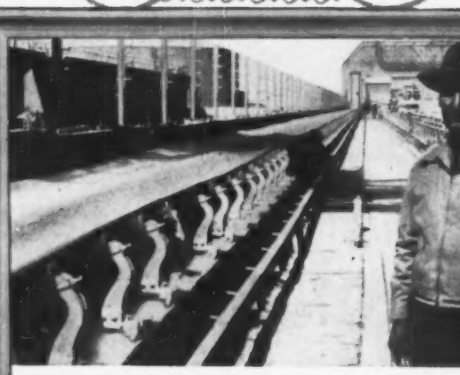
Mechanical Goods Division

**United States Rubber**

WORLD'S LARGEST MANUFACTURER OF INDUSTRIAL RUBBER PRODUCTS

Rockefeller Center, New York 20, N.Y. In Canada: Dominion Rubber Company, Ltd.

# HAULS OF



**For 12 years the tonnage went UP, UP, UP**

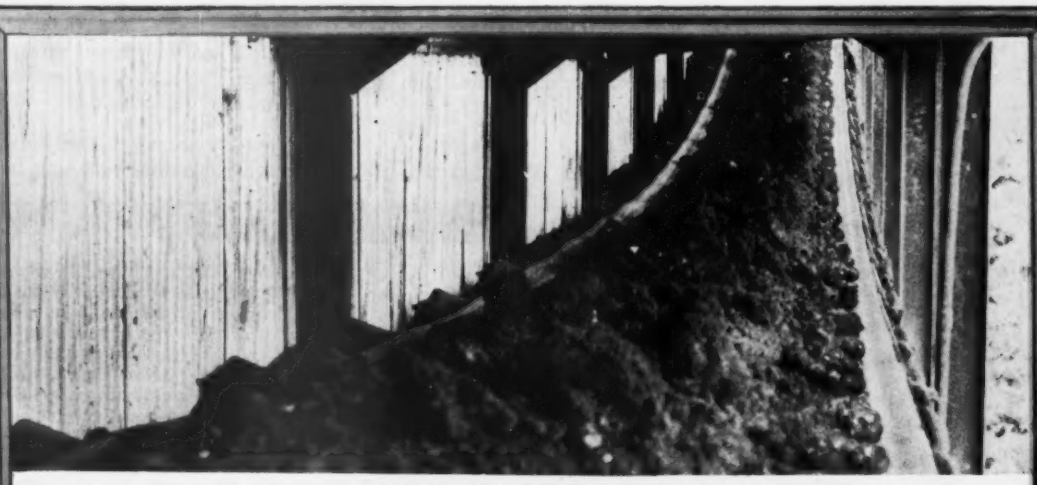
and down, went haulage costs for Chilean Exploration Co. This belt became a record breaker when it completed conveying the amazing total of 100 million tons of abrasive copper ore. Then it went on to surpass this figure, conveying a total of 130,886,134 tons at an average cost of $.00037 per ton.

Not only did this belt resist the extreme abrasive action of copper ore—it was completely unhoused and exposed to the blistering rays of the sun all year round.

THESE BELTS are just some of the "U.S." standouts which demonstrate, year after year, why "U.S." is the world's foremost authority on the design and production of conveyor belts.

For steady day-in-and-day-out dependability on conveyor belting, it always pays you to secure the advantages of "U.S." Engineering. "U.S." Engineers work directly with "U.S." Distributors or original equipment manufacturers to assure their obtaining the right belt for each type of conveying.

The most comprehensive belting engineering information in the industry is available through your "U.S." Distributor. It will pay you to check with him.



**GIANT of the CARIBBEAN**

The Reynolds Metals Co., in Jamaica, B.W.I., moves a million and a half tons of bauxite a year from back up in the hills to port-loading facilities. It's a tough, complicated job. Climate, rough terrain, abrasion, great distances—all have to be overcome. Dozens of "U.S." Belts move the bauxite underground and overland . . . first as cold, sticky, abrasive, run-of-mine ore, later as crushed fines right from red-hot drying kilns. These "U.S." Belts have been performing perfectly in this uninterrupted service.

# What's the difference in electrical cable?

## In USS Tiger Brand Amerclad it's better engineering and quality construction

*Engineered for the job.* USS Tiger Brand Amerclad Cables are used in such a variety of applications that "engineering for the job" becomes extremely important. Special constructions are designed for electric shovels, dredges, mining machines, welders and portable tools. Cable life depends on how well the engineers have anticipated all the destructive forces that a cable encounters in service.

*Quality construction.* USS Amerclad's highly flexible construction—rubber insulated conductors and Amerprene jacket—is carefully designed to give you superior electrical performance and mechanical reliability. Dynamically balanced rope lay conductors, as opposed to loosely bunched groups of fine wires, give balanced performance and long, trouble-free service through elimination of unequal tension and elongation.

Each conductor is separately insulated with Amerite, a tough heat-resisting, special rubber compound that exceeds the requirements of ASTM, and other industry standards. A rugged abrasion resisting Amerprene jacket protects the cable from mechanical abuse.

Tiger Brand Amerclad Cables are as tough as they come. They soak up shock and vibration, withstand crushing impact, severe jerking and pulling for unbelievably long periods. Used outdoors for mining, quarrying and excavating machines, Amerclad resists the constant wear and abuse from contact with rocky ground. And installed on lighter indoor equipment—electric welders, shop tools and motor leads—Amerclad gives top performance even when it's dragged over rough floors, through oil, grease or water.

Amerclad's greater durability will pay for itself many times in unfailing service, and ability to handle rated loads. It's the toughest electrical cord and cable money can buy.

*Send for catalog.* The Tiger Brand Amerclad Cable story is told completely in our new book we've reserved for you. We'll send the book without cost or obligation. American Steel & Wire, Dept. 0269, 614 Superior Avenue, N.W., Cleveland 13, Ohio.

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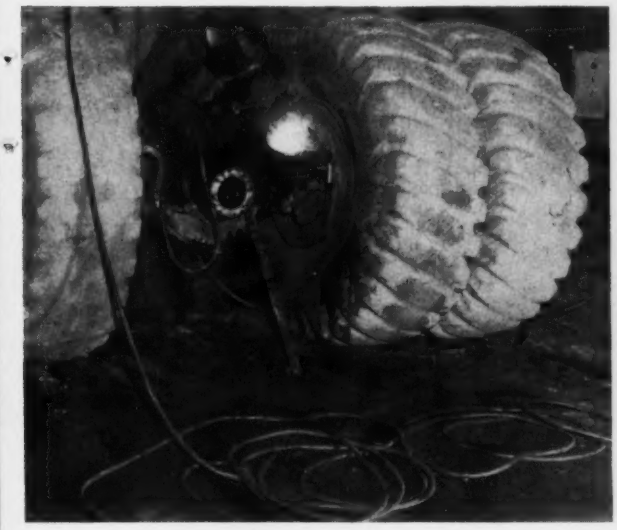
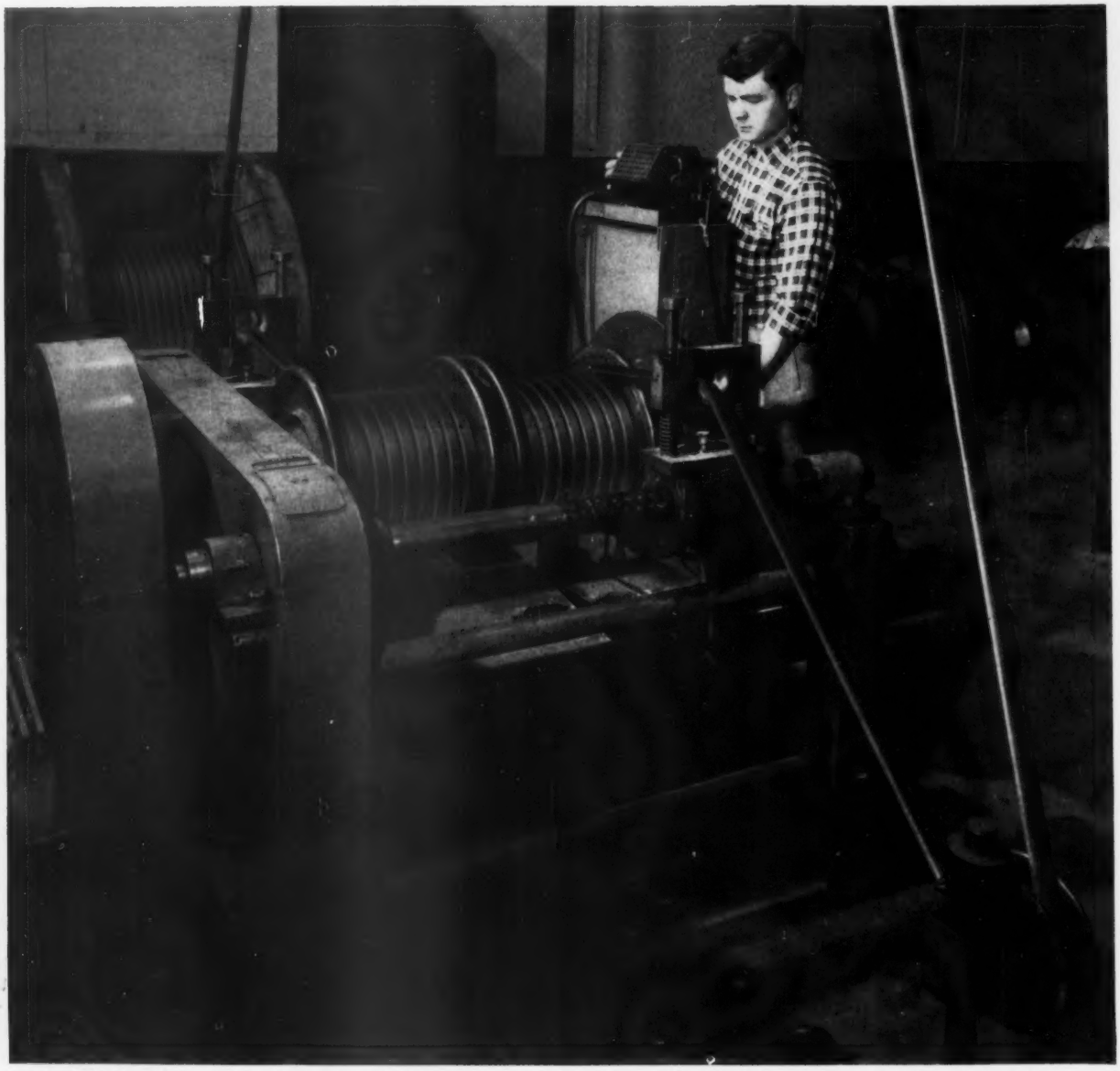




**Accelerated testing of cable.** This machine, designed by AS&W engineers, is testing mining machine cable to determine its resistance to reeling and pay off under tension, abrasion, flexing under tension, kinking under tension. Just one of the ways to determine the best insulating and jacketing compounds.

**From portable tools** to the largest power shovels, Amerclad Cables offer safe dependable service.

**It's how you mix** ingredients in just the right proportions that makes a big difference in cable performance.

USS **Tiger Brand Electrical Wire & Cable**

**A standard cable for every special job**

- Asbestos Wire and Cable
- Mold-Cured Portable Cord
- Shovel & Dredge Cable
- Paper & Lead Cable
- Varnished Cambric Cable
- Interlocked Armor Cable
- Special Purpose Wire & Cable
- Aerial, Underground and Submarine Cable

# CATERPILLAR ANNOUNCES 2 NEW

**NEW 150 HP 977H WITH 2½ CU. YD. BUCKET**

Travel speeds: Forward—Low: 2.0 MPH 1st; 3.6 MPH 2nd. High: 2.5 MPH 1st; 4.7 MPH 2nd. Reverse speeds 25% faster than forward.

**NEW 100 HP 955H WITH 1¾ CU. YD. BUCKET**

Travel speeds: Forward—Low: 2.1 MPH 1st; 3.9 MPH 2nd. High: 2.7 MPH 1st; 4.9 MPH 2nd. Reverse speeds 25% faster than forward.

# TRAXCAVATORS

## with Power Shift Transmission and Live Action Hydraulics

# 977 SERIES H
# 955 SERIES H

***all new for new high production***

There is a way to beat higher costs—and that's with increased production. For tractor-loader jobs, here's your answer in the new Series H Cat 977 and 955 Traxcavators. Designed to set a production pace far faster than the models they replace (and other makes of comparable size), they're milestones in tractor-loader progress. With power shift transmission and Live Action Hydraulics, they're the loaders *that never stop.*

There may be machines in your line-up that are no longer paying their way—or not earning *all* the profits they should. A comparison of your existing loaders with the new Series H Traxcavators could easily prove these new machines would increase your output and profits far more than you imagine. Get the facts from your Caterpillar Dealer. Ask for a demonstration, too. See for yourself how they set a new production pace on the toughest kind of job.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U. S. A.

**CATERPILLAR**

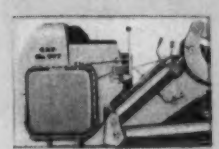
Caterpillar, Cat and Traxcavator are Registered Trademarks of Caterpillar Tractor Co.

**TRAXCAVATORS ARE MAKING OTHER LOADERS OBSOLETE**

***NEW HIGH PRODUCTION FEATURES SPEED LOADING, LIFTING, HAULING, DUMPING . . . THE FULL CYCLE***

**NEW POWER SHIFT TRANSMISSION**

One lever—that's right, one lever gives split-second changes in speed or direction to slash cycle times and increase operator efficiency.



**NEW LIVE ACTION HYDRAULICS**

Another Caterpillar development! Live Action Hydraulics provide faster lifting speed and greater lifting capacity without robbing power from the tracks. The 977H Traxcavator packs 41% more hydraulic lifting power—the 955H, 23% more than former models.

**MORE HORSEPOWER WITH NEW CAT TURBOCHARGED ENGINES**

Up 50% on the 977H—its new Cat D333 Engine develops 150 HP at the flywheel. Up 43% on the 955H with a new Cat D330 Engine that develops 100 flywheel HP.

**NEW INCREASED BUCKET CAPACITY**

An 11% increase on the new 977H with new 2½ cu. yd. bucket—and a 16.6% increase on the 955H with new 1¾ cu. yd. bucket. Complete redesign of engine, power train and chassis provides new machine balance to handle the heavier loads.

**NEW HEAVY-DUTY UNDERCARRIAGE**

Many new features, including larger, stronger track components that also increase stability . . . lifetime lubricated rollers with patented floating ring seals need no servicing . . . and track guiding guards welded to the roller frame for positive track alignment. The 955 Series H Traxcavator also features a new 6-roller track frame and hydraulic track adjusters, both standard equipment.

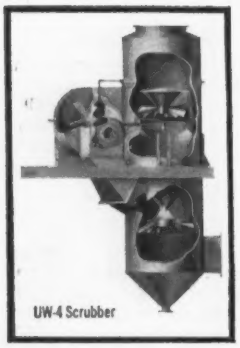
**MORE HIGH PRODUCTION FEATURES**

A new, two-cylinder gasoline starting engine for positive starts in any weather . . . and a new dry-type air cleaner that removes at least 99.8% of all dirt from intake air in the worst dust conditions, cuts maintenance time as much as 75%. Retained features include 40° bucket tilt back . . . automatic bucket positioners and kick out . . . 3-grouser track shoes.

**QUICK-CHANGE ATTACHMENTS**

Bar none, Traxcavators are the most versatile machines you can use. With attachments, you can always keep them working—and working profitably. Attachments available for the new 977 and 955 include the Side Dump Bucket, Rock Bucket, Quarry Bucket, Bulldozer, Ripper and Log and Lumber Forks.

## THE SWIRL, SWAT AND SCRUB METHOD OF CONTROLLING DUST



UW-4 Scrubber

There's an old song that goes something like this: "It Ain't What You Do; It's The Way That You Do It." This holds true for wet dust collection and one of the most effective ways of **doing** it is dynamically with a Ducon UW-4 Scrubber.

The centrifugal forces and water action inside this scrubber, combining with the unique and effective dynamic action of the high velocity fan in the second stage of operation, literally swirl, swat and scrub all the dust particles from the gas stream.

The UW-4 Scrubber is a most effective unit for separation of extremely fine dusts and abrasive materials and is ideally suited for heavy dust loads and high temperature applications.

*Send for Bulletin 7460.*

the name in Dust Control

THE **Ducon** COMPANY, INC.

147 EAST SECOND STREET • MINEOLA, L. I., NEW YORK

CYCLONES • CENTRIFUGAL WASH COLLECTORS • TUBULAR CLOTH FILTERS • DUST VALVES

Canadian Branch:

THE DUCON COMPANY, of CANADA, Ltd., 1131 Portit St., BURLINGTON, ONTARIO, CANADA



Shown are two 6 cu. yd. P&H Model 1600 Mining Excavators

# *Only from Cyanamid...*

## *Reagents for every mill feed!*
## *Service for every mining field!*

**AERO® Brand Cyanide**
**SODIUM Cyanide**
**AEROFLOAT® Promoters**
**AERO® Promoters**
**AERO® Xanthates**
**AEROSOL® Surface Active Agents**
**AEROFLOC® Reagents**
**SUPERFLOC 16® Flocculant**
**AEROFROTH® Frothers**
**AERO® Depressants**
**AEROSPRAY® 52 Binder**
**CYQUEST 40® Sequestering Agent**

Cyanamid offers world mining a complete line of flotation and cyanidation reagents—available from a single source. Cyanamid Field Engineers provide practical in-the-mill assistance in the most efficient use of these reagents. Our laboratory staff works patiently to develop improved reagents and application techniques to help you cut costs and improve your metallurgy.

We repeat: No other reagent supplier can serve you so broadly and so well. It pays to specify Cyanamid Reagents!

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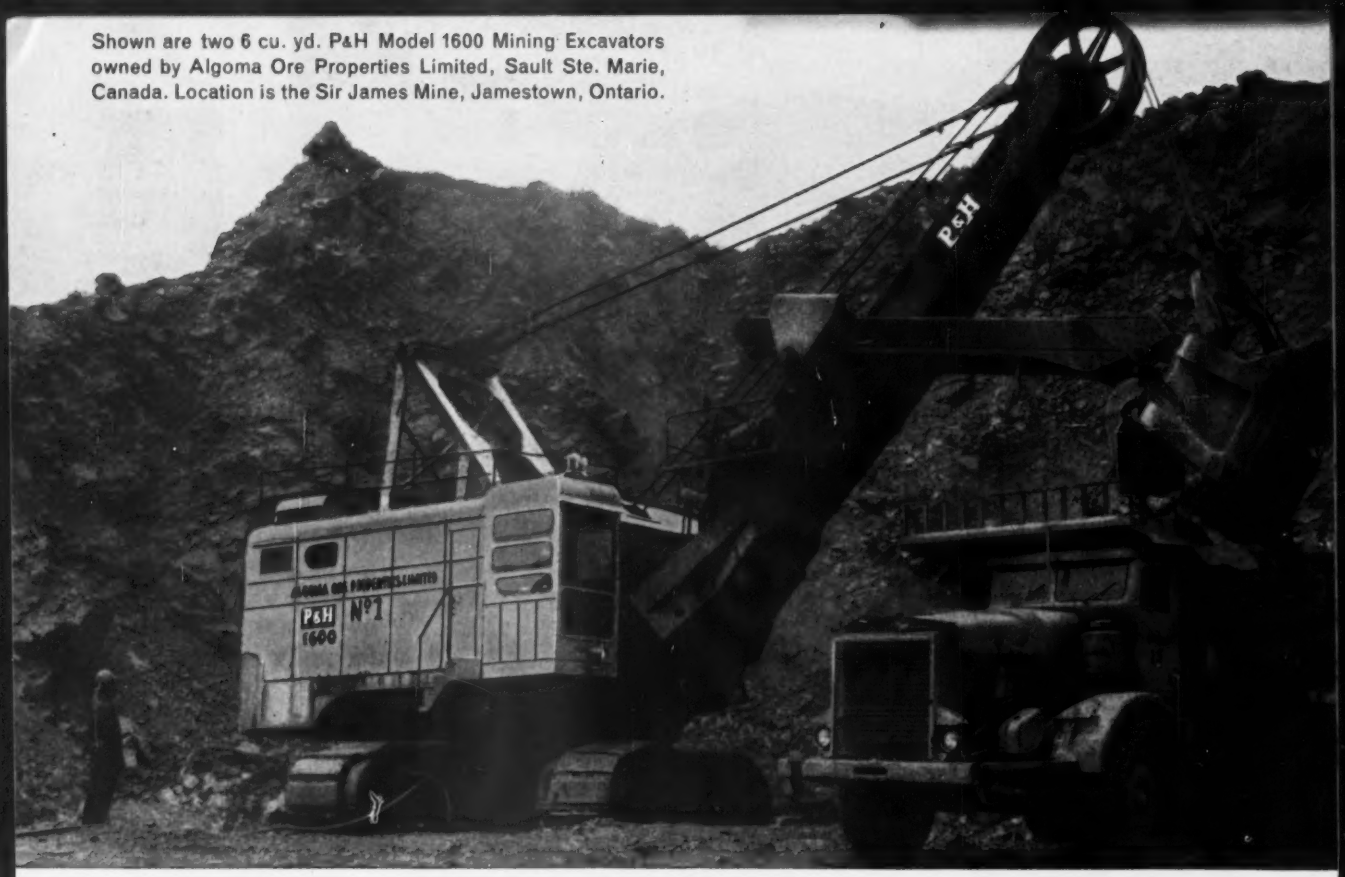
Shown are two 6 cu. yd. P&H Model 1600 Mining Excavators owned by Algoma Ore Properties Limited, Sault Ste. Marie, Canada. Location is the Sir James Mine, Jamestown, Ontario.




# AT ALGOMA ORE PROPERTIES,

LTD.

*One P&H always sells another because...*

# P&H "PROFIT-TONS" reduce loading costs in hardest digging

Up to 30% higher bail pull for more uniform dipper speed in the pile—faster swing—exceptional physical strength of P&H welded construction—greater job availability all add up to as much as 10% more production, lower loading cost per ton and *more net profit* for owners of P&H Electric Mining Excavators on their hardest digging assignment.

P&H "Profit-Tons" are the end product of these *exclusive* P&H design principles:

MAGNETORQUE® . . . the most productive digging motion drive known for electric excavators. This patented P&H hoist drive electro-magnetically transmits the full digging power of an A.C. hoist motor direct to the dipper *without motor generator set conversion to D.C. current.* It gives higher bail pull, greater dipper fill factor and automatic impact protection to the digging machinery.

ELECTRONIC CONTROL . . . this patented P&H control accomplishes the quickest work motion reaction time known on electric shovels. Control maintenance expense is reduced as much as 80% by elimination of all moving parts for a completely closed circuit system.

In addition, with P&H—and only with P&H—do you get the service assurance of single source responsibility. P&H manufactures their own electrical as well as mechanical components—*designed specifically for electric excavator service.* Write Dept. 607A, Harnischfeger Corporation, Milwaukee 46, Wisconsin.

**HARNISCHFEGER**
*Milwaukee 46, Wisconsin*

**P&H**

**P&H LINE:**
Electric Excavators: 3½ through 10 yds.
Diesel Excavators: ½ through 3¼ yds.
Truck Cranes: 10 through 80 tons

P&H equipment is also manufactured in Australia, Brazil, Canada, Germany and Japan.

*FOR EFFICIENT ACTION LIKE THIS ON YOUR NEXT SHOT...*

# WHICH EXPLOSIVE?

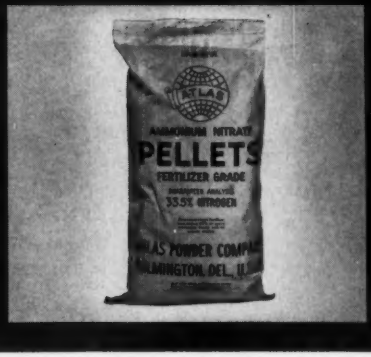
Modern developments in mining are constantly aimed at cutting costs and improving safety. One fast road to lower operating costs is thru better use of explosives and blasting techniques. For blasting in open pits or in underground stopes, drifts or shafts, mine operators are finding that their lowest true blasting costs depend on determining which explosives, and which blasting methods, combine to give the most uniform fragmentation, the best displacement, and the lowest overall cost.

The complete Atlas line of explosives, blasting agents, and blasting supplies is designed to provide every possible combination to meet each type of blasting problem, over a wide range of conditions. For example, in addition to the four shown here, there are also such specially developed products as Amodyn,® available in both high and low velocity grades; Ammodyte,® a new economy dynamite; and Giant "75" Primers for efficient detonation of blasting agents. It will pay you to investigate these and the many other products in the complete Atlas line. And as for the latest blasting techniques, that's the job of your Atlas Representative. He can help you determine just which combination of explosives and blasting methods will give you the best results . . . on every shot.

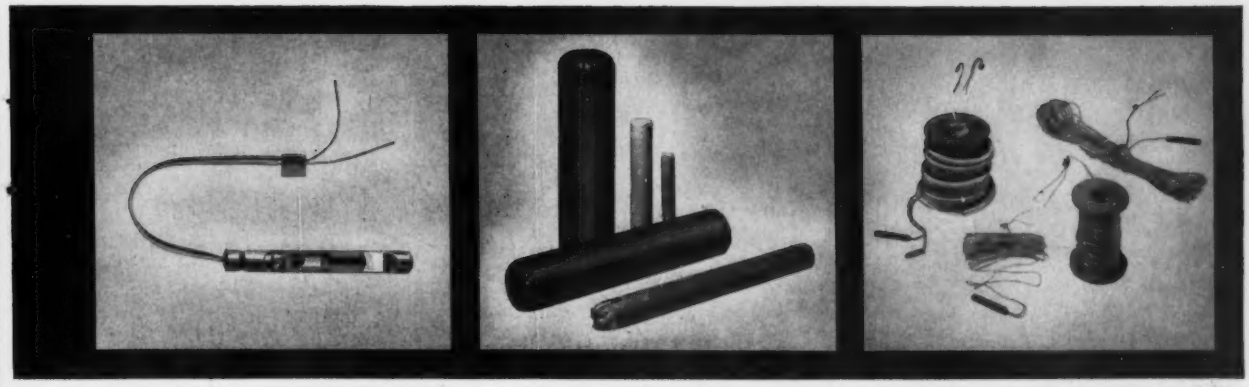
Our blasting cost chart, slide rules and technical literature are designed to help you determine your lowest true blasting costs. Ask your Atlas Representative, or write directly to:

**ATLAS POWDER COMPANY**
**Explosives Division, Wilmington 99, Delaware**

When you use the right combination,
all your equipment
moves in sooner...
works faster...
produces more.




**ATLAS PELLETS,** a new form of ammonium nitrate, have both the density and sensitivity required for efficient ammonium nitrate blasting.



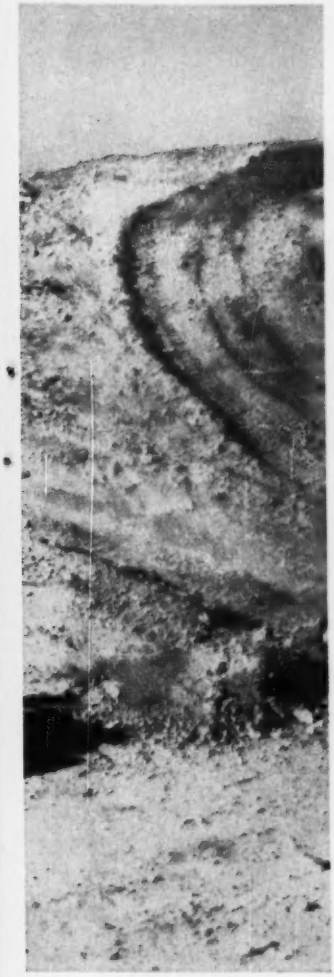
**MANASITE®** gasless delay electric blasting caps, most uniform timing in the field because of Atlas electric match and delay compound.

**GIANT GELATINS** for high velocity shattering action. They are advantageous for extremes of wet work and for hard, tight shooting.

**ROCKMASTER®** electric blasting caps achieve the staggered action so important in producing better breakage and control.

ATLAS EXPLOSIVES

JOHN DEERE



# STRIP... STOCKPILE... CLEAN UP...

## at low cost with John Deere Equipment

Here's equipment that pays its way faster because it works full time producing for you. All-around versatility keeps it going on more jobs—and John Deere's heavy-duty engineering means fewer hours lost in downtime.

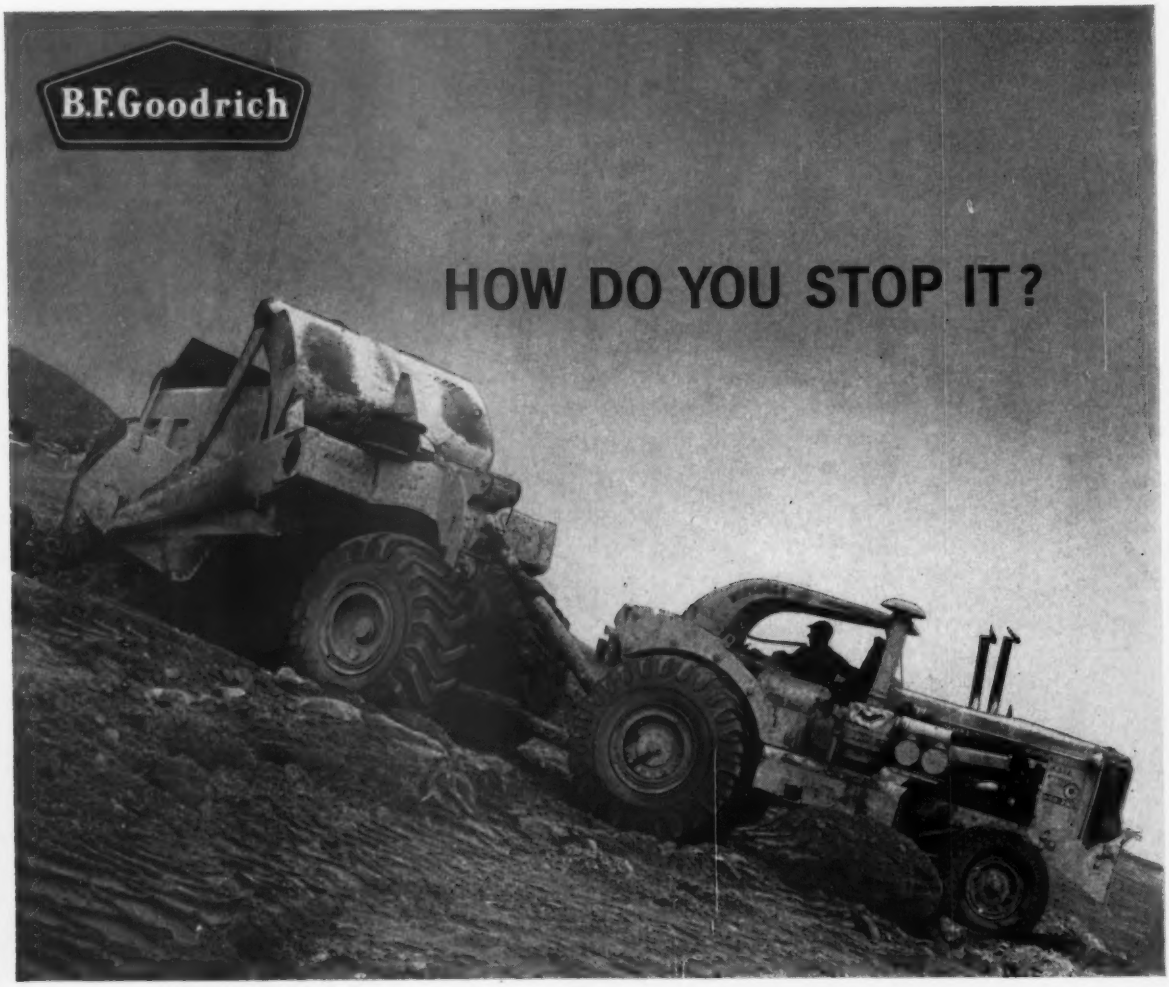
The John Deere "840" Diesel with elevating scraper loads sand, gravel, and heavy clay with the same ease and efficiency. A self-loading unit with fast hydraulic ejection, the 7-1/2-yard combination is designed to deliver high daily production at a minimum operating expense.

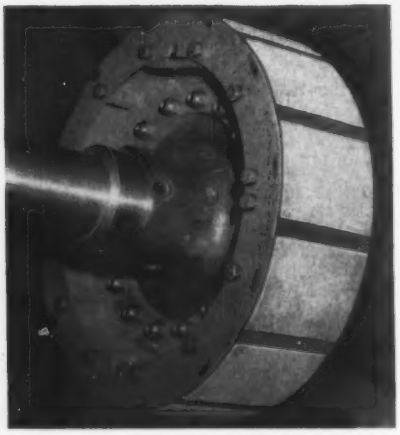
Loading and dozing go ahead at low cost with John Deere wheel and crawler units, too. The John Deere Crawler is available with 7/8-yard self-leveling loader and a choice of several efficient dozer blades.

For details on equipment, credit or leasing arrangements, see your John Deere Industrial Dealer or write today.

**JOHN DEERE** Industrial Division

3300 RIVER DRIVE, MOLINE, ILLINOIS



Hi-Torque brakes give uniform pressure, *full circle contact.* This provides maximum effective braking surface in the same size unit...double the braking power.

## HI-TORQUE BRAKES!

B.F.Goodrich Hi-Torque brakes cut stopping distance approximately in half, compared to conventional two-shoe brakes tested on identical vehicles and loads. The added safety factor with these brakes means you can haul bigger loads more safely, operate on faster cycles. More difficult off-highway jobs can be tackled.

For *double the braking power* on your heavy weight vehicles, specify Hi-Torque brakes as original equipment. These brakes are now available on heavy dump trucks, tractor-scrapers, coal haulers, mine trucks and other big vehicles, from several manufacturers.

For complete information ask the manufacturer of your equipment, or write *B.F.Goodrich Aviation Products, a division of The B.F.Goodrich Company, Dept. EM-6, Akron, Ohio.*

**B.F.Goodrich Hi-Torque brakes**

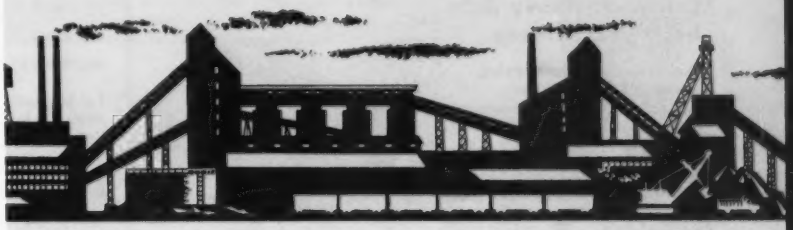
## ALLIS-CHALMERS PRODUCTS

Agglomeration Equipment
Agricultural Machinery
Algaecides
Anti-foams, Boiler Water
Arc Furnace Control
Betatrons
Boiler Feedwater Treatment
Breakers, Circuit (Power)
Car Shakers, (Railroad)
Circuit Breakers, Power
Clarifiers, forWater Conditioning
Classifying Equipment
Compacting Mills
Compressors, Axial, Centrifugal, Rotary
Condensers, Synchronous
Condensers, Steam
Construction Equipment
Contactors
Control, Electric Power
Converters, Copper
Converters, Electric
Coolers, for Cement Clinker, Chemicals
Core Dryers, Electronic for Foundries
Crushers, Gyratory, Jaw, Roll, Hammer
Deaerators, forWater Conditioning
Deflection Indicators, for Shafts, etc.
Deionizers or Demineralizers, for Water Conditioning
Dewaterers (Vibrating Screens)
Drives, Variable Speed
Dryers, for Rock, Ore
Earthmoving Equipment
Electronic Heaters
Engines, Gasoline, Diesel, Gas
Fork Lift Trucks
Foundry Shakeouts
Frequency Changers
Furnaces, Induction
Furnaces, for Ore Processing
Gearmotors
Generator Voltage Regulators
Generators, AC and DC
Graders, Road
Grinding Mills, and Media
Heaters, Induction and Dielectric
Heaters, for Rock, Ore, Grain, Chemicals
Hydroelectric Equipment
Kilns, Rotary
Log Washers
Magnetic Amplifiers
Material Handling Equipment
Mills, Blade, Grinding, Roller
Motor-Generator Sets
Motor Starters
Motors, Induction, Synchronous, DC
Motor Graders, Scrapers, Wagons
Nuclear Power Equipment
Pelletizing Equipment
Power Units (Engines)
Pulverizers
Pumps, Centrifugal and Axial
Pumps, Dry Vacuum
Rectifiers, Power
Regulators, Voltage
Regulators, Pressure (for Hydraulic Turbines)
Rheostats, Liquid
Road Machinery
Roller Mills
Screens, Gyratory, Vibrating
Scrubbers, Ore
Sifters, Gyratory
Slakers, Lime
Smelting Equipment, Ore
Softeners, Water (Commercial)
Starters, Motor
Substations, Indoor and Outdoor "Package" Types
Switchboards (Custom Built)
Switchgear, Metal-Enclosed, Metal-Clad, Indoor, and Outdoor
Tractors, Farm and Industrial, Wheel and Track Types
Transformers, Power, Distribution, Instrument
Turbines, Steam, Hydraulic
Valves, Ball, Butterfly, Howell-Bunger, Ring Jet, Rotovalve, Wafer
Washing Machinery, Rock and Ore
Water Treatment, Service, Chemicals, Equipment

# ALLIS-CHALMERS

## equipment for the

# METALLIC MINERALS INDUSTRIES



Allis-Chalmers is the world's largest manufacturer of equipment for the mineral industries. The wide variety of A-C products has brought together one of the most diversified groups of engineering specialists in all industry. That means you can get expert equipment recommendations from A-C.

There's no guesswork when you specify Allis-Chalmers Engineering. The A-C staff, working with your staff, analyzes your problem or process and looks for ways to make *existing* equipment "team up" with the new equipment for greater production. And the recommendation will be unbiased, because A-C builds many types and sizes of equipment. The selection will be dictated by *exactly what you need*, not an improvised arrangement.

Trained engineers in the Allis-Chalmers Research Laboratories help solve tough problems by testing samples of your product. This is another precaution to make sure that exactly the *right* equipment is selected for your particular plant.

And Allis-Chalmers not only builds the *basic* machinery, but *also* the motors and control needed to run it—it is the only company that builds all this machinery in its own shops. This means a "packaged" unit or process, with every part *engineered* to work efficiently with every other . . . assures you of higher efficiencies, lower costs, undivided responsibilities. And Allis-Chalmers stands behind every unit 100%! Sales offices and representatives are located near you . . . in all principal mining areas of the free world.

# ALLIS-CHALMERS

A-C ALLIS-CHALMERS

969 South 70th Street, Milwaukee, Wisconsin

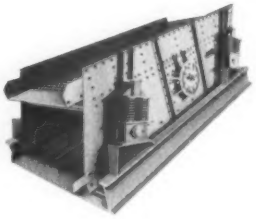
25 C 7949G

# VIBRATING SCREENS . . . a complete line

| SELECTION GUIDE | Maximum Feed Size (inches) | Aperture Range (inches) | Screen | Common Sizes (feet) |
|---|---|---|---|---|
| Scalping—ahead of Jaw Crushers | 36 | 3 to 10 | ROM Model XXH | 5 x 10 to 6 x 14 |
| Scalping—Following primary crushers | 20 | 1 to 10 | Model XH | 4 x 5 to 6 x 16 |
| Scalping—Following secondary crushers or hammermills | 6 | ¼ to 5 | Model SH | 3 x 6 to 6 x 16 |
| Dry Sizing | 6 | 40 mesh to 5 | Model SH | 3 x 6 to 6 x 16 |
| Dry Sizing | 5 | ⅛ to 2½ | *Low-Head* | 3 x 6 to 8 x 20 |
| Dry Sizing | 4 | 40 mesh to 3 | Model S | 3 x 6 to 4 x 10 |
| Dry Sizing | 4 | 40 mesh to 1½ | Model AVS | 3 x 6 to 4 x 10 |
| Wet Sizing and Washing | 6 | 40 mesh to 5 | Model SH | 3 x 6 to 6 x 16 |
| Wet Sizing, Washing and Dewatering | 5 | ¼ mm to 2½ | *Low-Head* | 3 x 6 to 8 x 20 |
| Wet Sizing | 4 | 40 mesh to 3 | Model S | 3 x 6 to 4 x 10 |
| Wet Sizing | 4 | 40 mesh to 1½ | Model AVS | 3 x 6 to 4 x 10 |
| Media Recovery and Washing | 8 | ¼ mm to 2 mm | *Low-Head* | 3 x 12 to 8 x 20 |
| Thickening, Dewatering and Filtering | ⅜ | ⅛ mm to 1 mm | *Low-Head* | 3 x 12 to 8 x 20 |

## Model XXH ROM inclined screens

**For the heaviest scalping problems**



Model XXH ROM screens are of heavy steel construction with balanced, two-bearing cartridge-type mechanism. May be obtained with plate or stepped grizzly bar decks. Max. opening — 10 to 11½ inches . . . 1 or 2 decks. Send for Bulletin 07B8368.

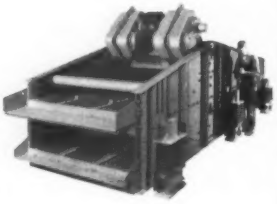
## Model XH Extra Heavy Duty inclined screens

**For wet or dry scalping and coarse sizing**

Model XH *Ripl-Flo* screens have balanced two-bearing mechanisms and may be obtained with perforated plate, rod or stepped grizzly bar decks. Max. opening — 10 inches . . . 1, 2 or 3 decks. Send for Bulletins 07B6151 and 07B7868.

## *Low-Head* Heavy Duty horizontal screens

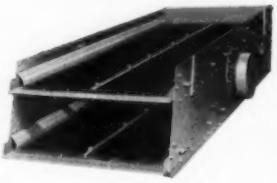
**For moderate to heavy sizing, coarse to fine, wet or dry, thickening dewatering, media recovery and rinsing.**



*Low-Head* screen operation saves headroom and space. Conveniently mounted mechanism imparts a straight line motion to screen. Max. opening—2½ inches . . . 1, 2 or 3 decks. Send for Bulletins 07B6330 and 07B7868.

## Model SH Standard Heavy Duty inclined screens

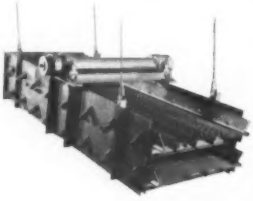
**For moderate to heavy sizing, coarse to fine, wet or dry, light scalping and rinsing**



Model SH *Ripl-Flo* screens have balanced, two-bearing mechanism and are designed for a wide range of applications. Max. opening—5 inches . . . 1, 2 or 3 decks. Send for Bulletins 07B6151 and 07B7868.

## Model AVS Standard Duty inclined screens

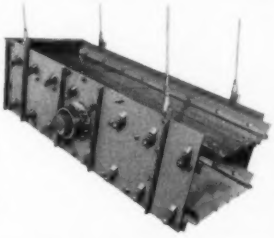
**For fine sizing, wet or dry**



Model AVS *Aero-Vibe* screens have two-bearing mechanism located above the body. Gives top screening efficiency at lowest possible cost. Max. opening—1½ inches . . . 1, 2 or 3 decks. Send for Bulletin 07B6099.

## Model S Standard Duty inclined screens

**For moderate, wet or dry sizing**



Model S *Ripl-Flo* screens are sturdy, low cost screens . . . have two-bearing mechanism. Max. opening—3 inches . . . 1, 2 or 3 decks. Send for new Bulletin 07B8229.

## MATERIALS HANDLING EQUIPMENT

CAR SHAKERS

TRACTORS AND GRADERS

MOTOR WAGONS

## WASHING EQUIPMENT

BLADE MILLS

LOG WASHERS

POOL WASHING SCREENS

## PYRO-PROCESSING EQUIPMENT

ROTARY KILNS . . .

**For sintering, nodulizing, pelletizing, agglomerating, calcining**

BALLING DRUMS

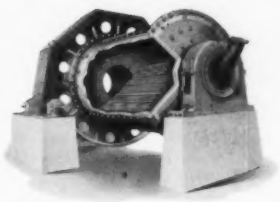
AIR QUENCHING GRATE COOLER

CONVERTERS

ROTARY COOLERS, DRYERS

FURNACES

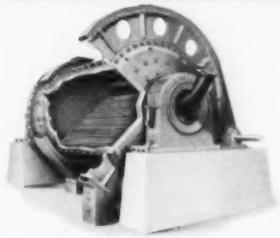
# GRINDING MILLS . . . all types



### Overflow Rod Mill

Sizes 3 to 11½ ft diameters, 6 to 16 ft lengths. Rod mill product can be varied from 6 to 35 mesh, with a minimum amount of fines. Because a rod mill can reduce a one inch slot size feed, it has supplanted the last stage of crushing in many plants. The screening action of the rods within the mill produces an ideal ball mill feed, free from tramp oversize, without the use of close circuiting screens.

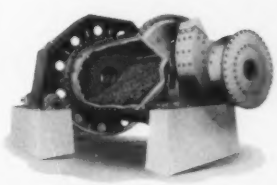
Bulletin 07B6718.



### Peripheral Discharge Rod Mill

Sizes 3 to 11½ ft diameters, 6 to 16 ft lengths. The peripheral discharge rod mill was developed for those dry grinding circuits where close control is required for either the product top size or the fines. In addition to these dry grinding applications, either the end peripheral or the center peripheral discharge rod mill may be used in wet circuits where specific product requirements must be met.

Bulletin 07B6718.



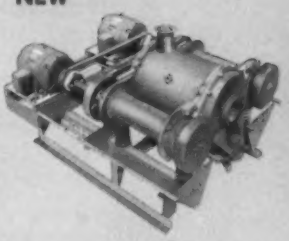
### Ball Mills

Sizes 3 to 13 ft diameters, 3 to 17 ft lengths. For producing a finely ground product of 28 to 325 mesh from a feed size of about ½ inch. Ball mills are unsurpassed for the fine grinding of moderately to extremely abrasive materials.

Overflow type ball mills are used for fine wet grinding in closed circuit with a classifier. Diaphragm type ball mills are universally used for fine or coarse, wet or dry grinding in closed circuit with a classifier, screen or air separator.

Bulletin 07B6718.

NEW



### Vibrating Ball Mills

**For small capacity applications, wet or dry grinding**

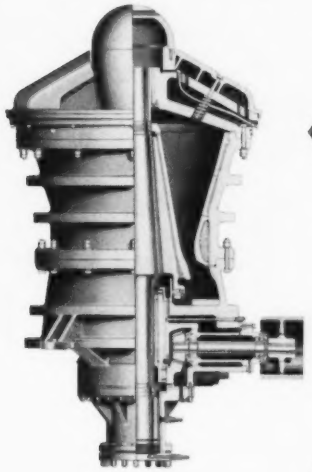
The VBM, a high capacity, exceptionally efficient grinding mill out-produces a tumbling mill 15 to 30 times per unit volume. Applications range from hard - to - grind abrasives to chemicals, foods, pharmaceuticals, pigments.

Versatile VBM can reduce a variety of products to specification . . . from coarse to very fine micron size.

15-inch and 30-inch diameter mills with capacities up to 1 tph and 5 tph, respectively.

Bulletins 07B7138 for 15 inch, and 07B9582 for 30 inch.

# CRUSHERS FOR EVERY MINING JOB



### *Superior* Gyratory Crushers

**For high capacity primary or secondary crushing**

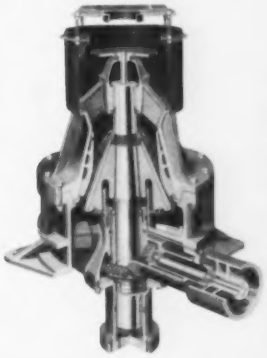
Twelve sizes . . . 16-50 to 60-109 (60 inch feed opening, 109 inch diameter cone at crushing point). Capacity 170 to 3500 tph. Available with *Hydroset* mechanism or spider suspension.

Bullein 07B7870.

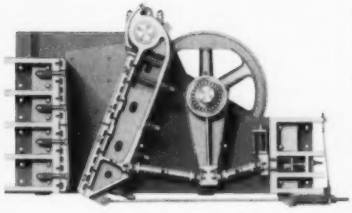
### *Hydrocone* Gyratory Crusher

**For high capacity secondary or tertiary crushing**

Twenty-one sizes . . . 122 to 1784 (17 inch feed opening, 84 inch diameter cone at crushing point). Capacity 7 to 1050 tph. Equipped with *Hydroset* mechanism. Bulletin 07B7145.



The *Hydroset* mechanism adds flexibility to gyratory crushing . . . an hydraulic mainshaft support which compensates for wear, adjusts product size and facilitates clearing of crusher in case of power failure or unexpected shutdown.



### Model ST Jaw Crusher

**For crushing moderately hard material with minimum fines**

Five sizes . . . 18x30 to 42x54 inch feed openings. Capacity, 75 to 650 tph. Bul. 07B8595.

### Blake Jaw Crushers

**For moderate capacity crushing of hard materials**

Five sizes . . . 10x7 to 30x18 inch feed openings. Capacity, 6 to 90 tph. Bulletin 07B7090.

### A-1 Jaw Crushers

**For primary crushing of tough, abrasive material in blocky feed sizes**

Four sizes . . . 36x25 to 60x48 inch feed openings. Capacity, 200 to 660 tph.

Bulletin 07B6369.

### Fine Reduction Jaw Crusher

**For crushing 7 inch and smaller feed to 50% passing ¼ inch in one operation**

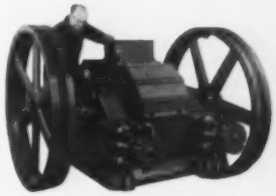
Two sizes . . . 18x9 and 24x10 inch feed openings.

Bulletin 07B6425.

### Roll Crushers

**For fine crushing of hard material with minimum fines**

Double-roll crushers are driven by large flywheel sheaves. Roll diameters from 9 to 78 inches. Bulletin 07B6180.



**For crushing large tonnages of laminar rock**

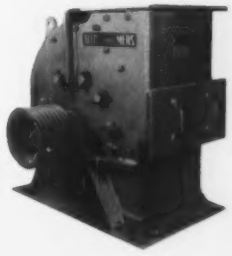
Single roll *Fairmount* crushers, two sizes . . . 24x84 and 36x60 inch rolls. Write for more information.

### *Pulverator* Hammermill

**For pulverating non-abrasive materials**

Hammers reduce material by multi-impact . . . large ratio of reduction. Handles up to 4 inch feed. Five sizes . . . capacity 2½ to 125 tph.

Send for Bulletin 07B6265.

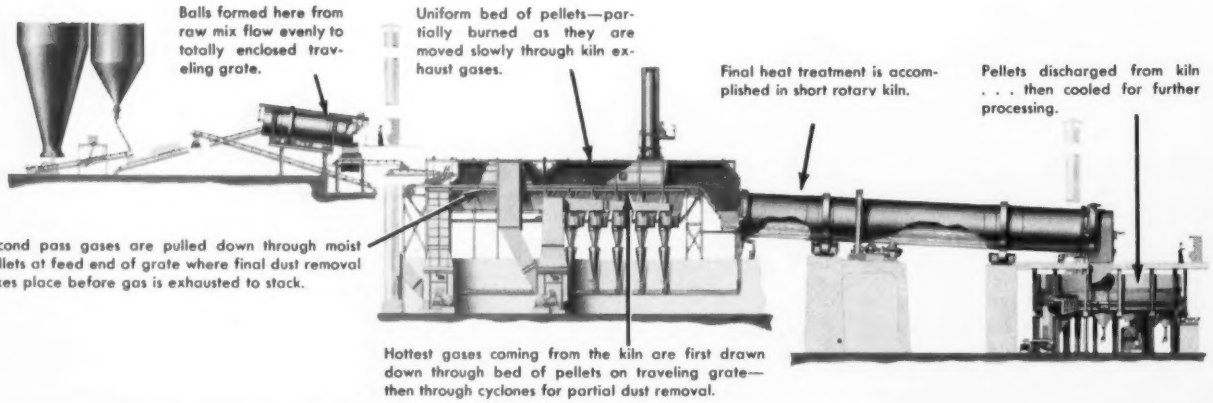


## THE GRATE-KILN SYSTEM

**The GRATE-KILN System is a new approach in pyro-processing involving preheating, burning and cooling. The system has been adapted to the following applications that result in the *highest quality product* at the *lowest cost*:**

Agglomerating phosphate sands, iron ores, refractory materials • Calcining lime • Dead burning of dolomite, magnesite.

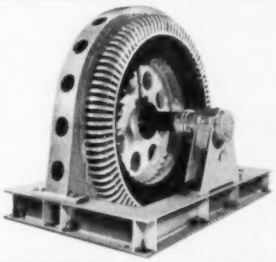
Typical system capacities: Iron ore—1000 to 4000 long tons per day, Lime—200 to 600 tons per day.


Balls formed here from raw mix flow evenly to totally enclosed traveling grate.
Uniform bed of pellets—partially burned as they are moved slowly through kiln exhaust gases.
Final heat treatment is accomplished in short rotary kiln.
Pellets discharged from kiln . . . then cooled for further processing.
Second pass gases are pulled down through moist pellets at feed end of grate where final dust removal takes place before gas is exhausted to stack.
Hottest gases coming from the kiln are first drawn down through bed of pellets on traveling grate—then through cyclones for partial dust removal.

## MOTORS FOR EVERY DRIVE

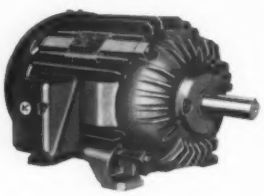
SUPER-SEAL MOTORS are one of the latest cost saving developments to come from Allis-Chalmers. These motors are built in two general types. One of them is insulated with *Silco-Flex* all-silicone-rubber insulation that has extreme resistance to dust and moisture and is repellent to surface water. The other has stators molded in epoxy-resin which provides a permanent shield against moisture and contamination. Open type *Super-Seal* motors may be used in most applications that formerly required enclosed motors. They are available from the smallest to the largest ratings. Bulletin 51B9040.

**LARGE CAGE MOTORS** — Built in sizes to meet all industrial, power plant, and special application requirements. Construction shown is available from 60 hp at 300 rpm to 2000 hp at 1800 rpm. 05B7542.

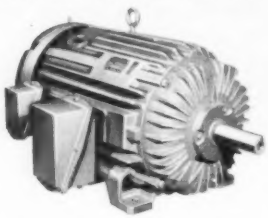


**SYNCHRONOUS**— Built in ratings from 40 hp up for a wide variety of speeds, including 3600 rpm motors in the larger sizes. Have high efficiency. Improve plant power factor for reduced power costs. 05R8183.

**DRIP-PROOF** — New NEMA rerated squirrel cage motors are available in standard ratings starting at ½ hp. Their better protection against foreign matter helps keep maintenance costs low. Bulletin 51B6210.



**TOTALLY ENCLOSED FAN-COOLED** —Ideal for dirty, dusty, oily, humid, corrosive, and outdoor locations. Rapidly moving air from the cooling fan keeps most dirt from settling on motor. Easily cleaned. 51B7725.

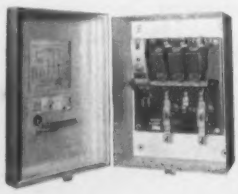


**WOUND-ROTOR MOTORS**— For constant speed duty requiring frequent reversing or starting under heavy load. Adjustable-varying speed loads. High starting torque applications, such as crushers, kilns, blowers. 51B8195.

**WEATHER-PROTECTED**—Design simplicity and the ability to operate under the most severe weather conditions are combined in this weather protected motor. Sizes from 250 hp up. Bulletin 51B8606.

## CONTROL FOR EVERY MOTOR

Allis-Chalmers makes a line of starters to meet practically all motor control needs. Count on this wide range of starters, backed by industry-wide application engineering experience, for the answer to your control needs. Ask for Bulletin 14R7988.



### Power Distribution

Allis-Chalmers also supplies a complete line of power distribution equipment to mining plants. This includes power, distribution, and instrument transformers; indoor and outdoor switchgear and unit substations; circuit breakers; power rectifiers.

### Tractor Equipment

Allis-Chalmers has geared its development progress to the earth moving and material handling needs of the mining industry and is supplying crawler tractors, tractor shovels, pull scrapers, motor scrapers, motor wagons, motor graders, and power units.

**ALLIS-CHALMERS**

**969 South 70th Street, Milwaukee 1, Wisconsin**

LITHO IN USA D&J-60

# Unshot Rocky Digging

This Marion 151-M works a 35-40 foot bank of unshot, rocky digging on the Iron Range. Its ability to produce low unit costs under difficult digging conditions has made the 151-M a familiar sight in open pit mines across the nation. Why not let a Marion mining specialist project 151-M unit costs on your property? For years, Marion has been recognized for recommending the right methods and the right machines to produce needed tonnage at the lowest possible costs.

CONSULT MARION MINING SPECIALISTS
*for lowest costs on your property!*

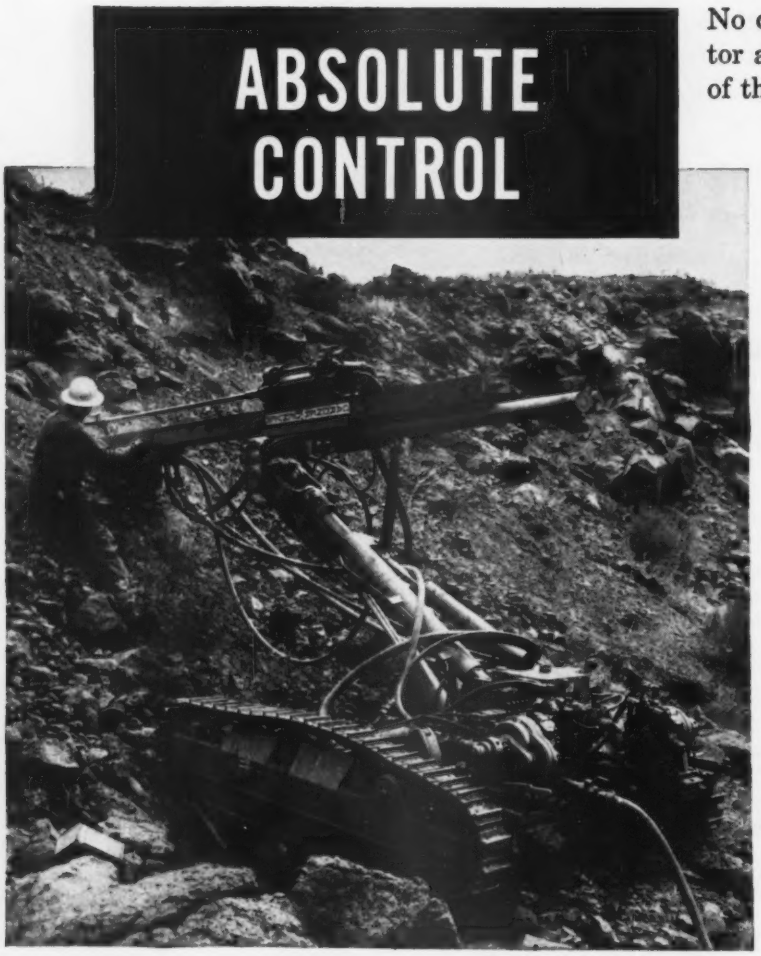
**MARION POWER SHOVEL COMPANY • Marion, Ohio, U.S.A.**

*A Division of Universal Marion Corporation*

# GARDNER-DENVER OPENS A NEW ERA IN PERCUSSION DRILLING

## No other rock drill compares with

# THE NEW GARDNER-DENVER



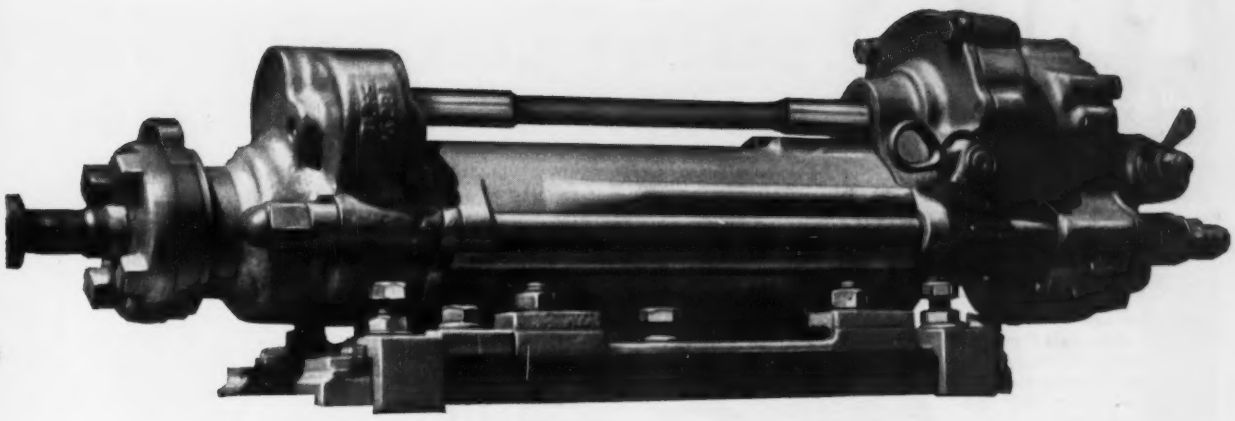

No other rock drill gives your operator absolute and independent control of these vital rock drill functions:

**Rotation without impact**—Efficient gear motor supplies powerful rotation in either direction, even when drill is not impacting. Three rotation speeds at the flick of a control. Neutral position stops rotation.

**Impact without rotation**—Separate control provides impact action without rotation. Percussion can be varied from light to heavy blows, and can be used to loosen couplings or stuck steel.

**Impact and rotation**—This unique drill provides light percussion and rapid rotation for drilling in soft rock . . . or heavy impact and slow rotation for hard rock.

**HIGH-POWERED DRILLING TEAM**—The new PR123 drill on the famed Gardner-Denver Swing-Boom "Air Trac"® makes an unbeatable rock drilling combination.



# POWER ROTATION MODEL PR123

## UP TO 30% FASTER PENETRATION

The new PR123 is the only rock drill which uses *all* hammer energy directly for percussion. There's no rotational drag on the piston hammer. Every blow is sharp and solid. Results: faster hard rock drilling than ever before. Depth of hole does not affect drilling speed as it does with a conventional rifle-bar-rotated drill. You can drill deeper holes with the PR123.

## SELECTIVE DRILLING

Now your operator can line up the right combination of rotation speed, impact force, feed pressure and hole blowing for fast drilling in any type of rock. No other rock drill provides absolute, independent and instantaneous control of impact and rotation. Drilling action can be changed as soon as the bit enters a new rock formation.

## NO ROTATION PARTS IN CYLINDER

The PR123 has no rifle bar, no ratchet ring, no pawls or other vulnerable internal rotation parts, and thus eliminates the most frequent causes of rock drill breakdown and maintenance. Instead, rotation is supplied by a long-wearing gear motor which is efficiently lubricated by the air line oiler. A torsion bar absorbs rotational shock between shank and motor.

## POWER COUPLING AND UNCOUPLING

Independent rotation control is a real time-saver when drilling with sectional rods and couplings. Rotation without impact permits power coupling of threaded rods without damage to the threads. Reverse rotation speeds uncoupling when coming out of the hole. Independent power rotation also helps free stuck steel.

**PROVEN DESIGN**—The new PR123 uses the same cylinder and automatic valve parts as the popular Gardner-Denver DH123. Renewable chuck driver liners for all sectional shanks. Piston diameter: 4½". Length: 38½". Weight, less mounting: 290 pounds.

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

# GARDNER - DENVER

Gardner-Denver Company, Quincy, Illinois
International Division, 233 Broadway, New York 7, New York
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario

# FALK

...a good name in industry

# QUALITY GEAR DRIVES and FLEXIBLE SHAFT COUPLINGS

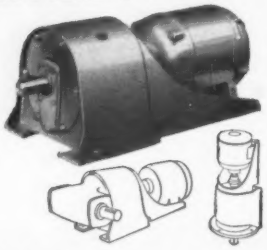
THE FALK CORPORATION, MILWAUKEE 1, WIS. *Representatives and Distributors in many principal cities.*

● The helical and spiral bevel gears in Falk gear drives assure maximum mechanical efficiency attainable—98½% per gear mesh under full load.

## ALL-MOTOR MOTOREDUCERS *up to 75 hp.*

All-steel units for use with any NEMA foot-mounted motors within rated capacities of the gear drives. Standard output speeds from 1 to 780 rpm (with 1750 rpm motors); as low as .032 rpm in semi-standard designs. Also Integral units, from 1 to 40 hp.

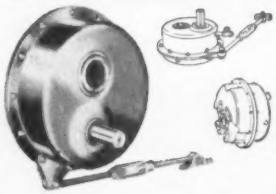
***Ask for Bulletin 3100.***



## SHAFT MOUNTED DRIVES *up to 50 hp.*

All-steel units, horizontal or vertical. Output speeds between 420 and 5 rpm. Maximum torque rating at low speed shaft: 44,000 lb-in. Consult Factory for higher capacities and for flange mounted drives.

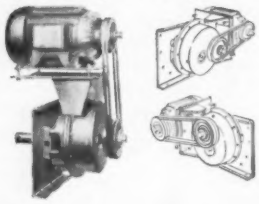
***Ask for Bulletin 7100.***



## SCREW CONVEYOR DRIVES *up to 30 hp.*

Bolt to any standard trough end. Output speeds from 420 to 5 rpm. Max. torque rating at low speed shaft: 21,400 lb-in. Drive includes removable drive shaft and seal housing with choice of seals. Trough end and Motor Mount optional.

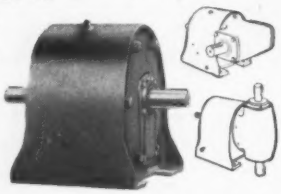
***Ask for Bulletin 7106.***



## SMALL SPEED REDUCERS *up to 350 hp.*

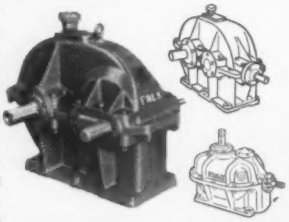
**Concentric Shaft** reducers with ratios from 1.49:1 to 970:1. Maximum torque at low speed shaft: 84,000 lb-in. **Right Angle** ratios from 5:1 to 1460:1. Maximum torque at low speed shaft: 73,000 lb-in.

***Ask for Bulletin 1105.***



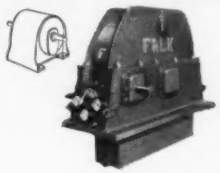
## LARGE SPEED REDUCERS *up to 3500 hp.*

**Parallel Shaft** up to 3500 hp. Ratio range: from 2:1 to 300:1. Maximum catalog torque at low speed shaft: 1,950,000 lb-in. Bulletin 1110. **Right Angle Horizontal** up to 1000 hp. Ratio range from 1.5 to 515:1. Max. catalog torque at low speed shaft: 569,000 lb-in. Bulletin 2105. **Right Angle Vertical** up to 760 hp. Ratio range from 6:1 to 430:1. Max. catalog torque at low speed shaft: 714,000 lb-in. Low speed shaft extension up or down. Bulletin 2110.



## HIGH SPEED DRIVES ... *reducers or increasers.*

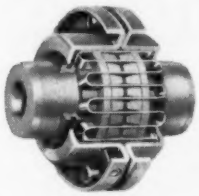
**Parallel Shaft** drives cataloged up to 5,000 hp or 10,000 rpm. Unit ratios from 1.15:1 to 12:1. Bulletin 5105. **Concentric Shaft** units cataloged up to 225 hp or 4500 rpm. Ratios from 1.5:1 to 25:1. Bulletin 1106.



## STEELFLEX COUPLINGS *protect connected machines.*

Hp range: ½ through 72,000 hp at 100 rpm. Exclusive grid-groove design cushions shock loads, accommodates reasonable degrees of shaft misalignment. Basic Type F for 9 out of 10 industrial applications, horizontal or vertical.

***Ask for Bulletin 4100.***



Basic Type F

## AIRFLEX COUPLINGS *Designed for mounting shaft-to-shaft, shaft-to-flywheel, or shaft-to-flange.*

15 sizes covering a range from 5 through 2880 hp at 100 rpm. Ideal for applications which have irregular torque characteristics in driving or driven machines (internal combustion engines, reciprocating compressors, etc.).

***Ask for Bulletin 8100.***

## SINGLE HELICAL and HERRINGBONE GEARS

Exclusive Falk extra-depth, high pressure angle gear teeth provide greater strength and protection against abrasion. AGMA ratings. Hub or ring gears in solid or split designs.

Diameters up to 23'-9" PD.

Face widths up to 6'.

Diametral Pitch: ¾ to 6 DP.

***Ask for Engineering Reports 6170 and 6171***

Ring Gears

Hub Gears

**Special GEAR DRIVES for any application.**

**Special HIGH SPEED DRIVES... over 50,000 rpm.**

**Marine PROPULSION DRIVES for turbine and diesel.**

FALK, ALL-MOTOR, and STEELFLEX are registered trademarks.

in uranium ore processing...

# TRONA®

# SODIUM CHLORATE!

## out-performs other oxidizing agents because of higher oxidizing power, economy and ease of handling

Experience proves that TRONA SODIUM CHLORATE is the best oxidizing agent you can use in the acid-leach process for recovering uranium values from its ores. $NaClO_3$ is more economical, too, because of its higher oxidizing power. It is rapidly and completely soluble; in the leaching circuit it forms a solution, not a suspension. Another advantage—Trona sodium chlorate shipping drums are suitable for re-use in shipping yellow cake. AP&CC, the largest domestic producer of sodium chlorate, has the knowledge, experience and facilities to produce a consistently better sodium chlorate for your milling operations.

**TRONA® SODA ASH** is used in acid and alkaline processes for the refining of uranium ores and as a pH modifier in the ore milling circuit. High quality Trona soda ash has applications also in the refining of lead dross and as an extractant of nonferrous minerals from low percentage ores by flotation.

*Write for $NaClO_3$ facilities, technical data and applications bulletin. Also available —an attractive and functional wall chart for chlorate handling precautions.*

TRONA

**American Potash & Chemical Corporation**

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*Sales Offices:* LOS ANGELES, NEW YORK, CHICAGO, SAN FRANCISCO, PORTLAND (ORE.), ATLANTA, COLUMBUS (O.), SHREVEPORT

*Producers of:* BORAX • POTASH • SODA ASH • SALT CAKE • LITHIUM • BROMINE • CHLORATES • PERCHLORATES • THORIUM YTTRIUM • RARE EARTHS • *and other diversified chemicals for Industry and Agriculture*

# DIAMOND BITS *and* CORE BARRELS

**SERIES D-3 — Core Barrel***

**This barrel is manufactured in EX, AX, BX, NX, and NC sizes. Available in 5 ft. and 10 ft. lengths it takes a core ranging in size from .840″ dia. (EX) to 2.400″ (NC). Incorporates new adjustable bearing assembly permitting vertical inner tube and bearing adjustments. Bearing suspended inner tube prevents core grinding and minimizes core erosion. This barrel is designed to recover maximum amount of core in all types of rock conditions. Tube borium hard faced strips on core barrel head retard abrasion, increase stabilization and extend core barrel life.**

**SERIES C-3 — Core Barrel***

**Increased annulus between tubes and between outer tube and hole allows this barrel to be used with either water, mud or compressed air. Manufactured with heavier wall tubing than conventional barrels for that heavy duty coring job. Includes adjustable bearing assembly and tube borium hard faced strips on core barrel head. Available in standard 5, 10, 15 and 20 foot lengths.** Core sizes range from 1.067″ dia. (AX) to 1.875″ dia. (NX). Because of decreased core size we do not recommend this barrel for coring extremely hard rock.**

**3-1/2″ x 2-1/8″ Core Barrel***

**This barrel is made for use with heavy duty drills. It can be used with water, mud or air and takes a 2-1/8″core. It is available in 5, 10, 15 or 20 ft. lengths. Illustrated is a detachable pilot-type core bit available for this barrel.**

**Recommend AX in 5 and 10 ft. lengths only.

*Chrome plated inner tubes available for above barrels upon request.

Christensen manufactures many modifications and adaptations of the above equipment. For detailed information on our complete line of diamond bits and core barrels, write for catalog SD508.

**Trouble-free operation — minimum maintenance — maximum core recovery. This is what you buy in Christensen core barrels. Barrels designed for every type operation and every size drill, from small prospector to heavy duty types.**

# FOR MINING EXPLORATION

The pilot type core bit has proved a most efficient style for core recovery in soft formations and is currently being adapted to many of our core barrels. Tungsten carbide grit hard facing is available.

A step or pilot type non coring bit reduces vibration and increases penetration rate. It is ideal for drilling long straight holes, pilot holes, blast holes, grout holes, drain holes and cement in diamond drill holes.

The casing shoe has box thread (pin thread available), extra hard matrix and 25 per carat size diamonds. Casing shoes are set without inside gage stones to allow a corresponding size bit and reaming shell to pass.

Here is a standard bevel wall impregnated core bit with light diamond concentration. It is designed to overcome the problems of hard, fractured, abrasive and, in general, difficult to core rock. There is no salvage or credit value for returned bits of this type.

New balanced type reaming shell, designed and perfected by Christensen, utilizes an extra hard matrix metal that increases shell life over that of the insert type shells. There is a slight additional charge for hard facing.

The casing bit has box thread (pin thread available) and extra hard matrix. It is used for collaring holes and for reaming a hole for casing.

*"Less cost per foot"*

**Rock differs in drillability from area to area. Christensen will custom design your bits to insure you of drilling at "Less Cost Per Foot." Contact Christensen today.**

*Mining Division of the*

**CHRISTENSEN DIAMOND PRODUCTS**

MAIN OFFICE AND PLANT 1937 SOUTH 2nd WEST
P. O. BOX 387 SALT LAKE CITY, UTAH

*Yesterday at 3:03*
*MacLeod & Co.*

**Went out of business**

(it could happen to you... TODAY!)

At 3:03 p.m. yesterday this clock stopped.

So did plant elevators . . . one of them mid-floors, with Mac Leod in it. Lights went out . . . computers, tabulators and typewriters "died" . . . critical plant equipment stood useless. Pumps handling continuous-flow processing coughed to a halt . . . and in the laboratories, a crucial experiment requiring weeks of costly preparation was hopelessly sabotaged.

Without the "safety valve" of *adequate* power-generating standby diesel units, thousands of dollars worth of water-cooled processing equipment was quickly "cooked" to scrap iron by the crippling paralysis of power failure.

Seconds before, a catastrophe could have been avoided . . . if a Fairbanks-Morse Opposed-Piston diesel had been on hand, ready to pay for itself within the first few fleeting minutes!

*When did you last review your standby power facilities? Yesterday? Eighteen months ago?*

When emergency threatens . . . be it electrical storms, high winds, floods, drouth, heavy snows or equipment breakdown . . . you want *adequate* standby power equipment. And you want *the best.*

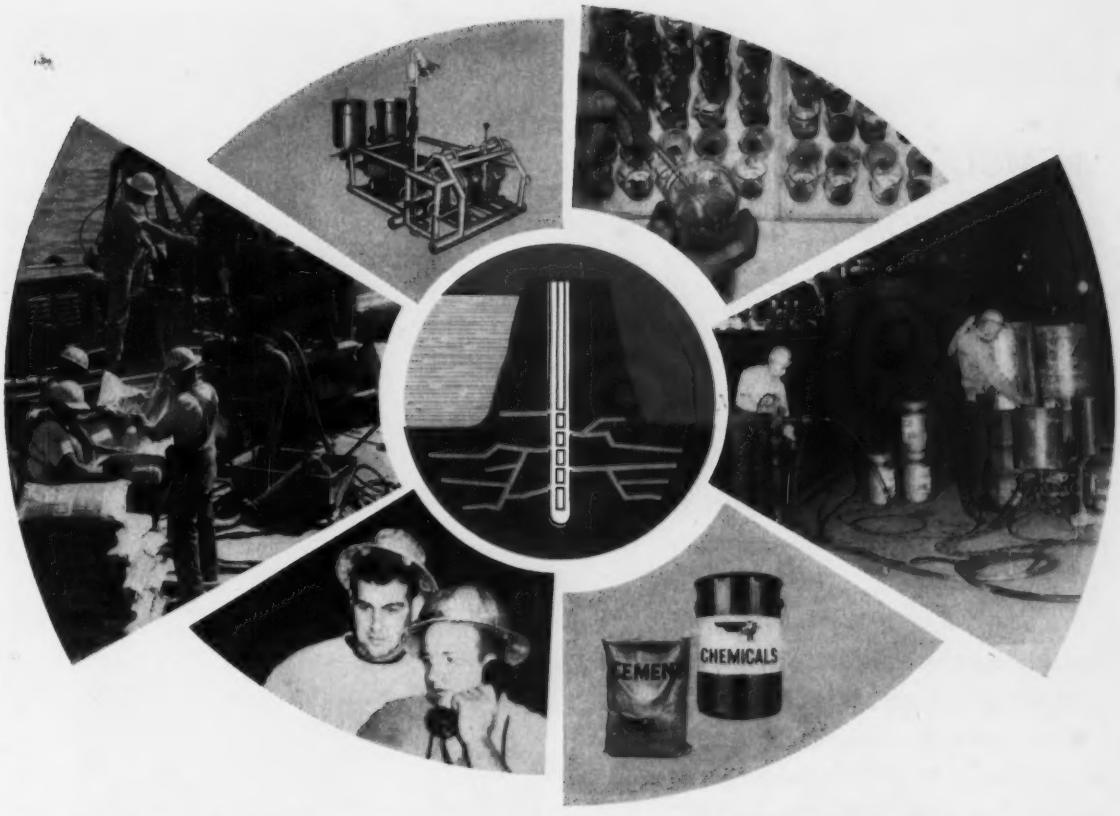
That, of course, means Fairbanks-Morse, pioneers of diesel building in America. No other manufacturer produces so great a variety of diesel engines for *all* services and purposes, from one-cylinder and five hp to 12-cylinders, 4200 hp . . . and *matching* generators, alternators and generator sets.

Get the facts why F-M two-cycle, Opposed-Piston diesel power . . . turbo-charged or otherwise . . . is unsurpassed for compactness, dependability and fuel savings. Drop a line today to: Fairbanks, Morse & Co., Diesel Division, Beloit, Wisconsin.

# Fairbanks, Morse

## DIESEL DIVISION

A MAJOR INDUSTRIAL COMPONENT OF **FAIRBANKS WHITNEY CORPORATION**




# *FULL SCOPE OF SERVICE*

Halliburton *Full Scope* Pressure Grouting Service offers a balanced selection of the best grouting methods and materials available today. To give you the complete picture of the many benefits of this outstanding service, Halliburton has prepared a comprehensive grouting brochure which is available now on request. A few of the advantages offered by Halliburton Pressure Grouting Service, and presented in this brochure, are outlined below.

## CHEMICAL GROUTING

. . . research designed and job proven for helping control unwanted water infiltration, seepage and leakage. Chemical grouts offered include HYDRO-LOK (PWG), HG-10 RESIN and BLOX-ALL. These low viscosity grouting agents contain an internal catalyst allowing injection as a single fluid for timed reaction. This permits the chemical grout to be injected in a single operation for closer control and more uniform setting throughout the entire permeability of the formation than with agent-plus-catalyst double injection chemical methods.

## CEMENT GROUTING

. . . with Halliburton cements, retarders and accelerators for helping to seal large fissures and solution channels in water-bearing formations . . . and special water-reactive cement grouts for use where troublesome water flows are encountered. These products — together with Halliburton research and know-how — give the greatest selectivity available for choosing the right grout — light or heavy, and the best setting characteristics — fast or slow.

***PUT THESE PRODUCTS AND TECHNIQUES TO WORK FOR YOU. When soil stabilization or water control problems point to pressure grouting . . . call on Halliburton . . . and Compare the Results!***

"275 LOCATIONS TO SERVE YOU"

# HALLIBURTON
## PRESSURE GROUTING SERVICE

A DIVISION OF HALLIBURTON OIL WELL CEMENTING COMPANY • DUNCAN, OKLAHOMA

## *WEMCO HEAVY MEDIA SEPARATION PLANTS AND EQUIPMENT:*

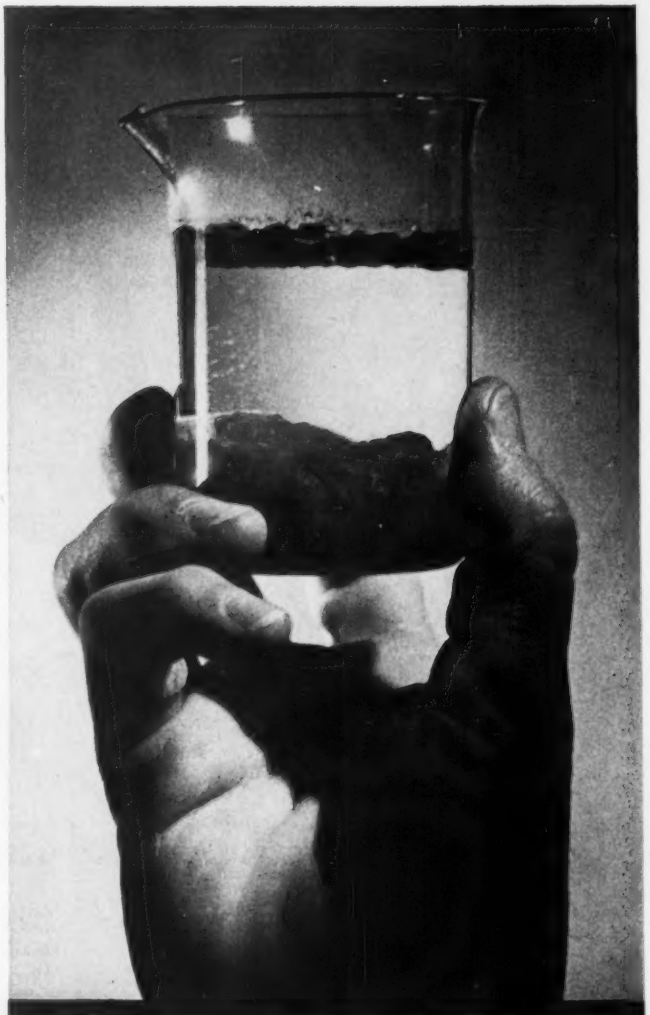
### *Operators' Choice—World Wide!*

*The choice of the heavy media separation process for profitable, premium production is a sound one.*

*And the choice of Wemco for HMS plants or equipment insures superior results and lowest-cost per ton treated.*

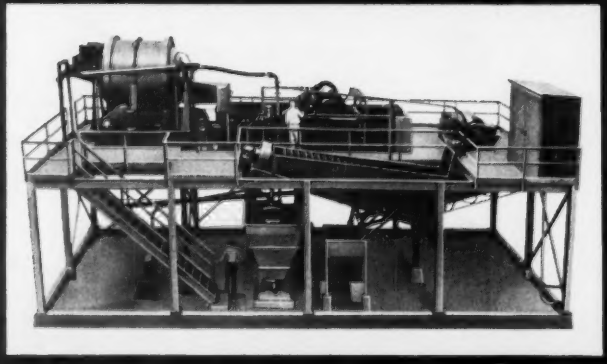
*Know-how is the answer to the Wemco record in HMS. Since the development of the very first HMS plants, Wemco technical knowledge and equipment—or complete plants—have accounted for more than half the installations around the world.*

*Small wonder that Wemco is considered the standard of Heavy Media Separation everywhere.*



### *THE WEMCO MOBIL-MILL:*

*Pre-engineered, prefabricated; ready for profitable production from the first day of operation. Nearly 200 of these complete plants are in operation. The Wemco Mobil-Mill is the answer—for positive results, known-in-advance costs.*



WEMCO®

*a division of*
**Western Machinery Company**
**650 Fifth St., San Francisco 7, Calif.**
*and throughout the world*

## 25% additional service with Yellow Strand "POWERSTEEL" at Watauga Stone Co.

"Rugged" is the only way to describe the job of digging rough shot rock out of this Tennessee quarry. It takes rugged equipment to match the job and for this reason, Watauga Stone Co., Carter County, Tennessee, specifies Yellow Strand "POWERSTEEL" Wire Rope.

Hoist and crowd lines take quite a beating—they used to last 3 weeks on this big 2½ yd. shovel. Three years ago Watauga tried—and liked—Yellow Strand "POWERSTEEL" Wire Rope. They found Yellow Strand "POWERSTEEL" runs an average of 4 weeks—6 days per week, 8-hour shifts—between hoist and crowd rope changes. They report, "We're more than satisfied with Yellow Strand "POWERSTEEL."

25% longer life is an excellent average. B & B's extra high strength rope is designed for heavy loads and abrasive conditions. It's available right now from your Yellow Strand Distributor. Call him! *Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.*

**Yellow Strand®**
**"POWERSTEEL"®**
**WIRE ROPE**

TRACTION MAGIC with

# ROLLS OUT OF

**KON-TORK differential automatically applies power to the driving wheel with firmest footing . . . moves the 230-hp Allis-Chalmers TR-260 through the toughest going.**

In mud, sand or other slippery going, you can rely on the Allis-Chalmers TR-260 to move you out of trouble. KON-TORK differential automatically controls the amount of torque delivered to each driving wheel. When one wheel hits soft going, KON-TORK takes hold and transfers torque from the slipping wheel to the wheel with solid footing . . . keeps the 20-ton capacity TR-260 on-the-go. With KON-TORK, normal and complete steering control is available at all times.

KON-TORK differential is just one of many features you'll like in the TR-260. You'll also appreciate the *21-inch underclearance at the tractor*, and *25¾-inch wagon*

**. . . move ahead with**

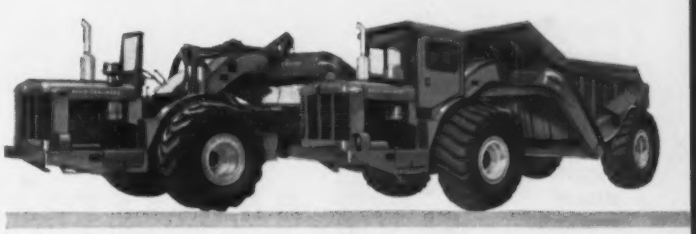
# TROUBLE

KON-TORK is an Allis-Chalmers trademark.

*underclearance* that prevents hang-ups in rough terrain, and the *really sharp 180-degree turns in less than 26½ feet* . . . unmatched by conventional haulers.

Let your Allis-Chalmers dealer give you all the facts on the 20-ton capacity TR-260 and the 12-ton capacity TR-160. Allis-Chalmers, Construction Machinery Division, Milwaukee 1, Wisconsin.

*You get double value and lower basic equipment investment when you use the 9.5-cu-yd TS-160 and 17-cu-yd TS-260, the 12-ton TR-160 and 20-ton capacity TR-260. Both can be interchanged . . . together they eliminate need for specialized equipment.*



**ALLIS-CHALMERS . . . power for a growing world**

# 40 STORIES *from Pit to Surface*

## ...IT'S R/M CONVEYOR BELT FOR LONG LIFTS!

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RM1016

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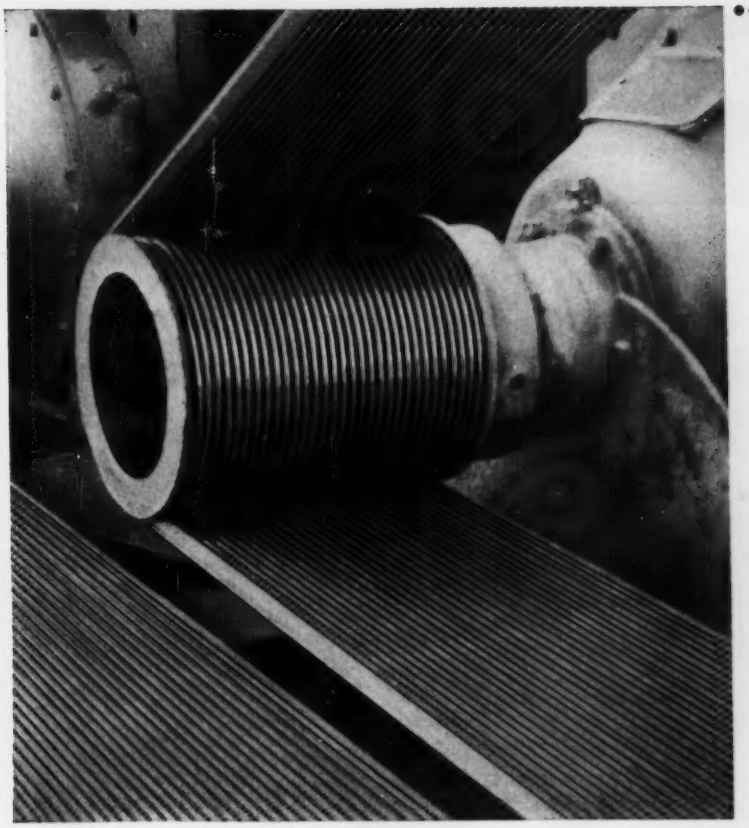

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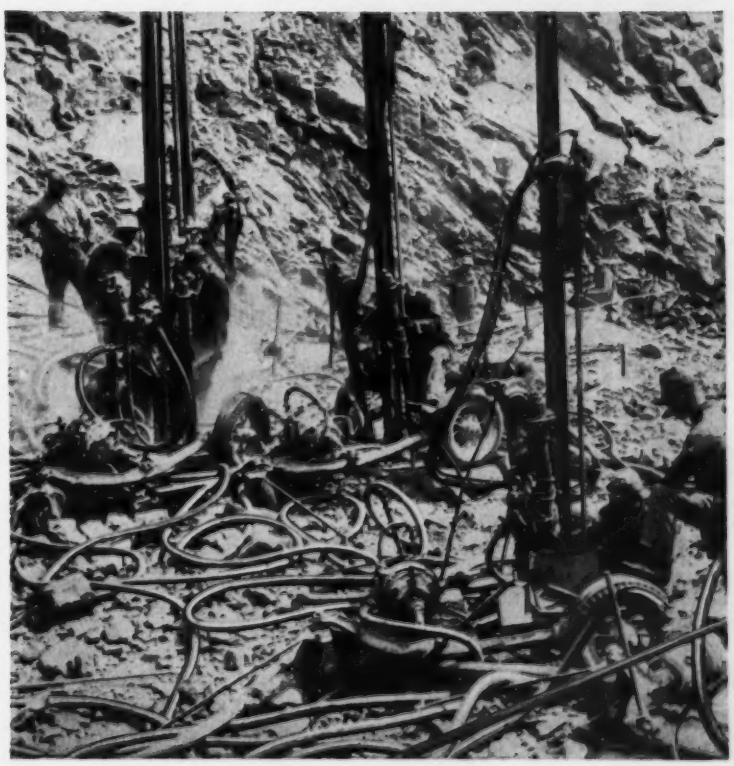

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ENGINEERING AND MINING JOURNAL

JUNE 1960

# The Discipline of Gold in the 'New Era'

SPEAKING before the Copper & Brass Research Institute at Hot Springs, Va., Elliott V. Bell, editor and publisher of BUSINESS WEEK said that the United States faces a "new and critical era."

Principal reason, he said, was the persistent drain on gold and dollar assets required to settle deficits in international payments. During the 1949-58 period these deficits averaged about $1.5-billion per year. In 1958, he said, the deficit suddenly jumped to $3.4-billion, and in 1959, to $3.7-billion. Further comment by Mr. Bell is quoted as follows:

"The United States program of international assistance has been, in effect, like a huge pump-priming program, conducted on a global scale. It has financed a tremendous foreign demand for American goods, and it has made possible the rebuilding of Europe's industrial plant.

"Obviously when this great outpouring of dollars comes to an end, world trade will lose something that has been a prolonged and powerful stimulus. There will, I think, no longer be room for doubt that the era of world-wide post war inflation is over; the big question will be whether deflation must inevitably follow?

"Now, why must our great global pump-priming program that has done so much good be ended?

"No country, not even the United States, can keep on giving away its money to foreigners forever without reaching the bottom of the barrel. How soon the bottom of the barrel is reached depends on two factors: one, the willingness of foreign central banks and governments to keep on accumulating dollar balances without asking for gold; two, the reserves of gold available should it be asked for.

"At present we have left about $19-billion in gold, a very large sum, and far more than any other country has. However, foreigners now hold just about $19-billion of short-term dollar assets for which they could demand gold.

"This brings us to the most important reason why our balance of payments deficit is disturbing. Any substantial conversion of foreign dollar balances into gold would have a restrictive effect upon our economy. Under the workings of our money system, gold withdrawals tend to reduce the money supply, tighten credit and bring about deflation. This is the discipline of the gold standard. Under the gold standard, nations which pursued loose fiscal policies, had persistently unbalanced budgets or persistent deficits in their international balance of payments, soon found themselves losing gold and had to mend their ways promptly or risk being forced off gold.

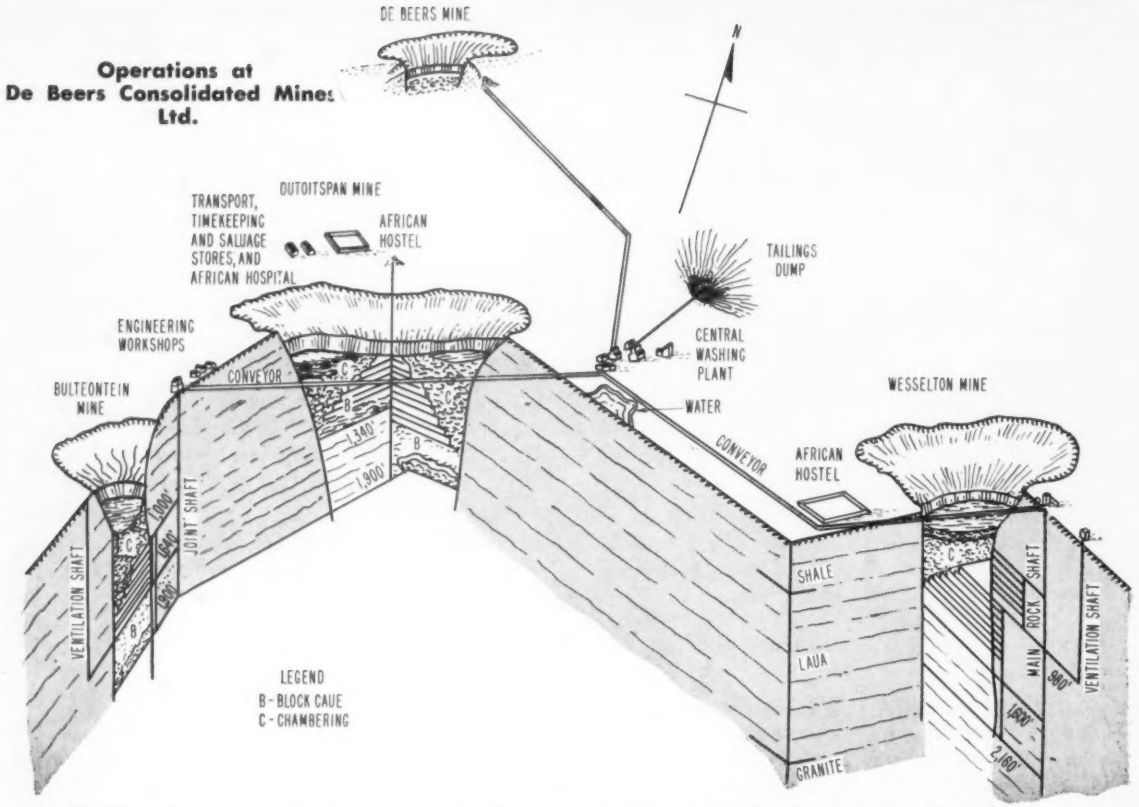
"In the period of world-wide depression in the 1930's, this gold standard discipline proved insupportable and country after country abandoned the gold standard and adopted 'managed money' policies. They were willing to let the external, foreign-exchange value of their currencies fluctuate in order to be free to take whatever steps they wished to maintain economic stability at home.

"Now all of the principal countries of Europe have stabilized their currencies. In effect, the world has returned to a gold exchange standard. Since the United States has maintained from 1934 a fixed price for gold at which it will sell to foreign central banks and governments, most countries keep only part of their reserves in gold and a large part they keep in dollars. The dollar has thus become the principal reserve currency of the world. As such it will be narrowly watched and there must be absolutely no question about our ability to meet instantly in gold all demands that may be made on us.

"The practical consequence of this is that, for the first time in a quarter century, the United States has lost the freedom to take whatever fiscal or monetary measures it sees fit to maintain domestic economic stability. For the first time since the early 1930's we are subject to the discipline of the international gold standard.

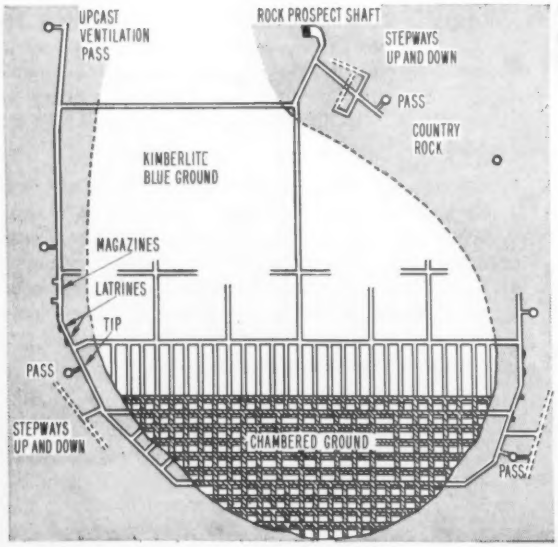
"Let me spell that out. Since the end of World War II, we have had four recessions. Each has been comparatively mild and short-lived. In each case the government has taken steps to combat the recession by reducing interest rates or running a budgetary deficit or both. In the recession of 1958, for example, interest rates were sharply reduced and the Federal budget went into the red for $12.5-billion dollars.

"If a new business recession were to start next month, it is highly unlikely that the Federal authorities would feel free to follow again the same anti-recession policy of drastically cheapening money and unbalancing the budget. To do so would almost certainly result in a substantial outflow of gold as foreign central banks, governments and others withdraw some of their balances from this market in fear of dollar depreciation."




**BLOCK CAVING,** introduced in 1953, has proved to be more economical than chambering. De Beers directly controls four producing mines and is associated with companies operating the Premier Mine, at Pretoria, and the Williamson Mine.

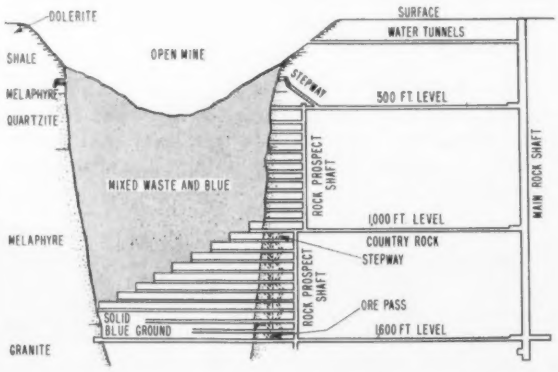
# Mining Blueground at De Beers




**SUCCESSIVE** chambers or slots, 12-ft wide and 40-ft high, are mined across the pipe with 10-ft pillars between them.

**W. S. Gallagher**
**General Manager**
**De Beers**

DE BEERS CONSOLIDATED MINES LTD. can proudly claim the distinction of being foremost in its field of mining ever since the company's inception in 1888. Not only has it remained the world's largest producer of gem dia-




**MAIN HAULAGE** crosscuts are driven from a five-compartment main shaft to the Blueground pipe at 600-ft intervals.

monds, but it is still the pioneer in the science of recovering the precious stones from the imprisoning rock.

At present, the operating mines immediately controlled by De Beers Co. are the Dutoitspan, Bultfontein, Wesselton and Jagersfontein mines; the Kimberley and De Beers mines having been closed for a number of years. The Premier Mine near Pretoria, the Williamson Mine in Tanganyika and the alluvial deposits in Southwest Africa and Namaqualand are operated by associate companies.

For some time after the finding of the first South African diamond at Hopetown in 1866, the diggers confined their activities to the banks of the Orange and Vaal Rivers. But in 1869 and 1870 when diamonds were discovered at Jagersfontein, approximately 100 miles from Kimberley, and on the adjoining farms of Bultfontein and Dutoitspan in the Kimberley area, they moved to the dry diggings, so-called in contrast to the earlier alluvial diggings.

In 1871 two more mines, Kimberley and De Beers, were located within a few miles of Dutoitspan and Bultfontein. It was then that the greatest diamond rush of all time took place. Men from all four corners of the earth came to seek their fortunes on the diamond fields. From the first diggings a mighty diamond empire has arisen, and with it the city of Kimberley in the heart of South Africa, over 600 miles from Cape Town and 300 miles from Johannesburg.

**MINERS** relax between shifts on administration block lawn at Dutoitspan Hostel.

## Geology

The diamond bearing ground, known as kimberlite or blueground, occurs at Kimberley and Jagersfontein in the form of volcanic pipes, which cut nearly vertically through the surrounding country rock. It is assumed that these pipes, as well as others to be found in South, Central and East Africa, the United States, India and Russia, are due to some deep-seated zone of weakness in the earth's crust.

Kimberlite is an ultra-basic lava, porphyritic in texture, with inclusions varying from purely igneous material to purely sedimentary breccias. The diamond forms an extremely minute quantity of this bluish rock, which contains other minerals such as garnet, olivine, ilmenite and chrome-diopside.

The kimberlite pipes differ not only in size and shape but also in the type of diamond they produce. Dutoitspan Mine is noted for its large yellow stones and Jagersfontein for its high quality blue-whites, some of the more famous being the 971 carat Excelsior diamond and the 634 carat Reitz diamond. At the time of its discovery in 1893, the Excelsior was the largest diamond in the world.

At the surface, the kimberlite weathers to a soft, yellow rock. This fact misled many diggers into believing that a deposit was worked out when, at a depth of 40 to 50 ft, they reached the harder blueground. It was in the Kimberley Mine that the first real excavation of this harder and richer blueground was undertaken. A study of the mine clearly illustrates the methods of development used, not only in the Kimberley Mine but in the other mines as well, since initially they were all developed along similar lines.

## Early Mining

Immediately after its discovery, the Kimberley Mine was divided into claims 30 ft square, each digger having his own small piece of ground to work. Roadways, 15 ft wide, were left between every double row of claims to allow easy access to all parts of the mine. As the ground at the surface was a loose, friable breccia, the slightest degree of undercutting caused the roadways to collapse on the claims below, and by 1872 they had all disappeared.

The tools used by South Africa's first miners were simple and consisted of little besides a pick, shovel and bucket. Despite the primitive methods used, the Kimberley Mine was soon a deep, oval, open crater, 1,000 ft in length with a maximum width of 600 ft. A strange haulage system was slowly introduced to take buckets of blueground to the surface. Thousands of ropes were stretched from the claims to windlasses and guide wheels, set upon a massive timber staging erected around the perimeter of the mine. The buckets of ground were thus hoisted to the mine edge and the empty buckets returned.

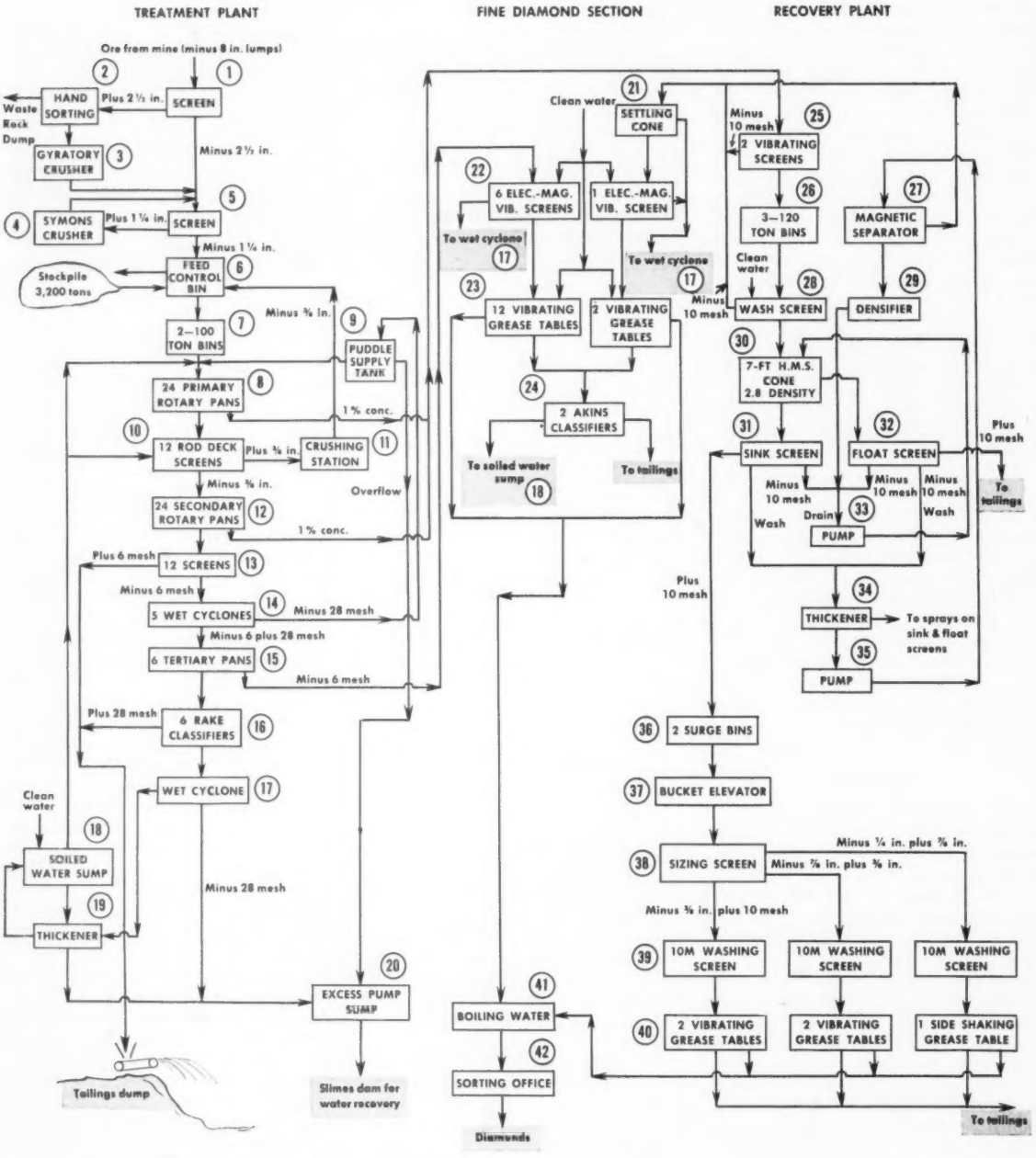
Hand manipulation of the haulage ropes was soon replaced by the horse whim. Finally, in 1875, steam winding gear was introduced and heralded the application of modern methods.

No amount of ingenuity, however, could prevent the flooding of the mine by water or the frequent and dangerous falls of basalt reef from the unstable mine walls. This was especially true as long as single claimholders worked the claims. Even in 1881, when the Jagersfontein Mine was being operated by two syndicates, the mine was completely flooded and had to be dewatered at a cost of £5,000.

Some consolidation of holdings did, of necessity, take place in the Kimberley Mine and several companies were formed. Numerous attempts were made to remove the fallen reef by means of shafts sunk in the country rock or by means of inclined tramways up the sides of the open mine. But by 1882, when the lowest working was at a depth of 400 ft, it had become necessary to remove three tons of reef in order to recover one ton of blueground.

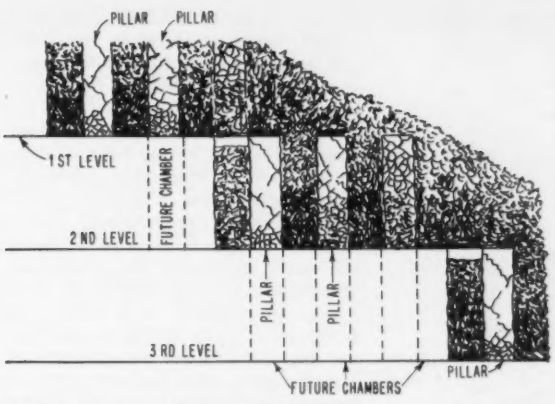
It was at this time that the first shaft was sunk at the bottom of the open pit. It extended through the overlying rubble into the blueground. Several such shafts were sunk by the various companies, thus allowing the blueground to be recovered and at the same time avoiding the necessity of driving expensive and lengthy tunnels through the surrounding country rock. A form of pillar and stall mining was used. Parallel tunnels were driven from the shafts, and chambers were excavated at intervals along the tunnels. To support the workings, pillars of blueground were left between the chambers. Soon the whole mine resembled a gigantic honeycomb. Because each company used a different method of mining and worked on different levels, severe crushing took

## Flowsheet of Treatment Plant, Fine Diamond Section and Recovery Plant, De Beers Consolidated Mines Ltd., Kimberley, South Africa




### LEGEND

1. Two 5-ft x 10-ft Gyrex screens with 2½-in. openings
2. One 42-in. conveyor picking belt
3. Two 9K Allis-Chalmers gyratory breakers
4. Two 4¼-ft Symons standard cone crushers
5. Two 6-ft x 14-ft Gyrex screens with 1¼-in. openings
6. One 200-ton bin
7. Two 100-ton bins
8. Twenty-four 14-ft rotary washing pans
9. One Steady head puddle supply tank
10. Twelve 5-ft x 10-ft—7½-in. Allis-Chalmers Ripl-flow rod deck screens with ⅜-in. openings
11. Four 5½-ft Symons short head crushers in closed circuit with eight 4-ft x 8-ft Symons rod deck screens with ⅜-in. openings
12. Twenty-four 14-ft rotary washing pans
13. Twelve 5-ft x 10-ft Allis-Chalmers Ripl-flow screens with 6-mesh openings
14. Five 42-in. wet cyclones
15. Six 14-ft rotary washing pans
16. Six 8-ft x 18-ft — 4-in. Dorr rake classifiers
17. One 42-in. wet cyclone




**LEVELS** are carried "en echelon," with each chamber, on any level, three cuts ahead of the chamber on the level below.

**Table 1. Bultfontein Experimental Block Cave Section Efficiencies**

| | |
|---|---|
| Cost per ton mined (delivered to skips) | 12½ d |
| Tons per case of explosives | 400 |
| Tons per European shift | 1,200 |
| Tons per African shift | 86 |

**Table 2. Details of Mine Projects**

| | Dutoitspan Mine | | Bultfontein Mine | |
|---|---|---|---|---|
| Level | 1,350-ft | 1,900-ft | 1,220-ft | 1,900-ft |
| Number of drifts | 15 | 29 | 6 | 31 |
| Number of drawpoints | 250 | 550 | 67 | 620 |
| Mean vertical lift | 300 ft | 600 ft | 600 ft | 400 ft |
| Estimated tonnage | 4 million | 21 million | 2 million | 14½ million |

18. Two soiled water sumps
19. One 50-ft Dorr thickener
20. One excess puddle sump
21. One settling cone
22. Seven Jeffrey-Galion 30-in. x 68-in. electro-magnetic vibrating screens with 28-mesh openings
23. Fourteen vibrating grease tables
24. Two 48-in. Akins classifiers
25. Two 3-ft x 6-ft Tyler trough washing screens with 10-mesh openings
26. Three 120-ton bins
27. One 24-in. Memco electro-magnetic belt separator
28. One 5-ft x 10-ft Allis-Chalmers low head screen with 10 mesh openings
29. One 2-ft Akins classifier
30. One 7-ft H.M.S. cone
31. One 3 x 10-ft Allis-Chalmers low head screen with 10-mesh openings
32. One 4 x 16-ft Allis-Chalmers low head screen with 10-mesh openings
33. One 3-in. Wilfley pump
34. One 10-ft Dorr thickener
35. One 1½-in. metal lined pump
36. Two 10-ton surge bins
37. Two 8-in. bucket elevators
38. One 3 x 6-ft Tyler trough washing screens with ⅞-in. and ⅜-in. openings
39. Three 3 x 6-ft — 6 Vibrex screens with 10-mesh openings
40. Two vibrating grease tables
    One side-shaking grease table
41. Two boiling tanks
42. Sorting office with electro-static separator

Note that the process gives a final reduction of approximately 20-million to one. The daily production of diamonds amounts to 2,800 carats (1.25 lb) from 13,000 tons of ore mined and treated.

Water is carefully conserved throughout the process and is extracted from the tailings before their disposal on the dumps.

The diamonds are delivered to the Diamond Producers Association for sorting and valuation.

place and work once more came to a standstill. The mine had to be completely re-opened.

The other mines, learning from the mistakes made in the Kimberley Mine, took steps to avoid the flooding of the mines by fallen reef. In the De Beers Mine attempts were made to remove the overburden surrounding the open mine, while at Dutoitspan a border of solid blue was left around the mine to support the sides. These expedients were only temporary and the sides soon collapsed.

It became imperative for a single company to control the underground workings in each mine and to provide the necessary capital required for large scale operations. In 1880, the De Beers Mining Co. was formed. By 1887 it had bought up all the claims in the De Beers Mine and many in the Kimberley Mine. In 1888 an amalgamation occurred between this company and the Kimberley Central Co., the chief claimholder in the Kimberley Mine. De Beers Consolidated Mines Ltd. had come into being and had control over both the mines. Shortly afterwards the company gained control of the Bultfontein and Dutoitspan mines and also of Wesselton Mine, which was discovered in 1890. Systematic underground mining could now be undertaken and the future of the diamond mines was assured.

The Jagersfontein Mine was administered by the New Jagersfontein Mining and Exploration Co. from 1887 until it closed down in 1932. De Beers only gained control over the mine in 1946 when it was re-conditioned prior to being reopened in 1949. However, the New Jagersfontein Co. was so closely linked with De Beers that the methods of mining used in the Jagersfontein Mine hardly differed from those employed in the mines at Kimberley from 1887.

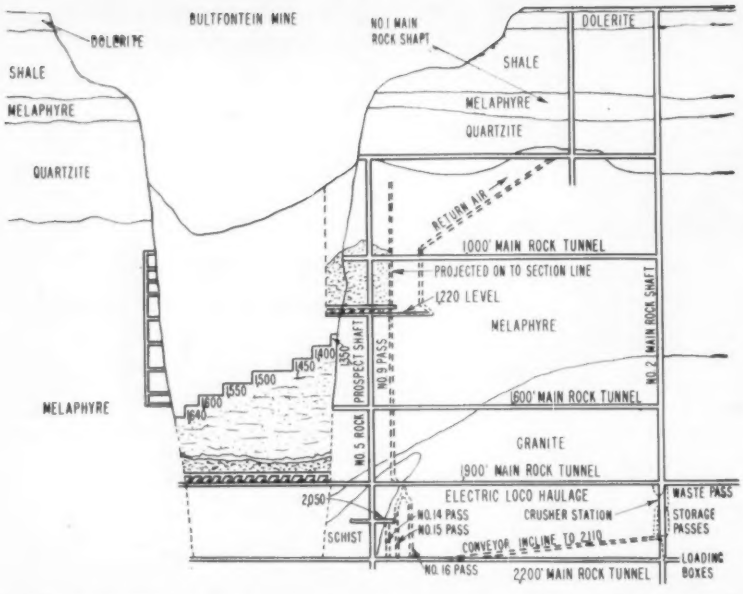
## Underground Mining

In 1887 the De Beers mine was being worked according to the Gouldie system (a modified fill system). In this method a form of chambering was carried out on successive levels. Once the chamber had been excavated its full length and the roof of the uppermost chamber had been broken away, the waste rock was allowed to fall in and fill the chamber almost up to the tipping pass. The broken ground thus formed an arch above the unfilled chambers, its weight being largely supported by the extremites of the arch resting on solid ground. In this way the crushing weight of the overburden, which had caused the failure of previous underground systems, was avoided. The main disadvantage of the Gouldie system was the frequency with which the small ore passes, down which the mined ground was tipped, became blocked.

The above method of mining was replaced by "chambering" shortly after the De Beers Mine became the sole property of the De Beers Mining Co. This system has persisted with little change throughout the mines up to the present day.

## Chambering

In chambering, a five-compartment shaft is sunk at an approximate distance of 1,000 ft from the pipe to avoid damage to the shaft by breakback from the open mine when subsidence occurs. The main haulage crosscuts are driven from the shaft to the pipe at 600-ft vertical intervals and are connected by means of a subvertical, three-compartment, man-and-material shaft about 100 ft from the blueground pipe. The chamber levels, at 40-ft vertical intervals, are developed from the shaft. On each of the chamber levels, successive cham-




**THE LOCATION** of the block cave projects was determined by existing chambering development. Undercutting has started on the 1,900-ft level of the Bultfontein Mine.

**AT JAGERSFONTEIN,** block caving once resulted in serious deterioration of all workings in the mine and surrounding rock, between the 900-ft and 1,950-ft levels.

bers or slots, 12 ft wide and 40 ft high, are mined across the pipe with 10-ft pillars between them.

Six chamber levels are required to obtain 4,800 tpd of ground. When the uppermost chamber level has been worked out, another level is started below to replace it. The levels are carried "en echelon," with each chamber on any level three cuts ahead of the chamber on the level below. This prevents the lower workings from weakening those higher up. The chambers on alternate levels are staggered so that any chamber is always cut under a pillar on the level above it.

Loading tunnels are driven at right angles to the chamber on 22½-ft centers. All the ground, broken in the chambers and caved from the pillars, is hand-loaded into cars in the tunnels and trammed to ore passes located in the country rock around the periphery of the pipe. From the bottom of the ore passes, the ground is hauled to the shaft along the lower crosscut by an endless rope haulage and is then hoisted to the surface. As the ore in the pipe is mined out, the main shaft is deepened by 600 ft and a new haulage level is prepared along this horizon. The average life of a haulage is 15 years.

Chambering has served the diamond mines very well, having been used in all the mines at Kimberley and in the Jagersfontein Mine. However, chambering became progressively more difficult at depth because of the hard and slabby nature of the kimberlite in the lower regions of the pipe. Too, it was expensive in both labor and development, even though the average cost was only 6s per ton mined. Labor efficiencies of 6 tons per shift per person underground compare favorably with more highly mechanized projects.

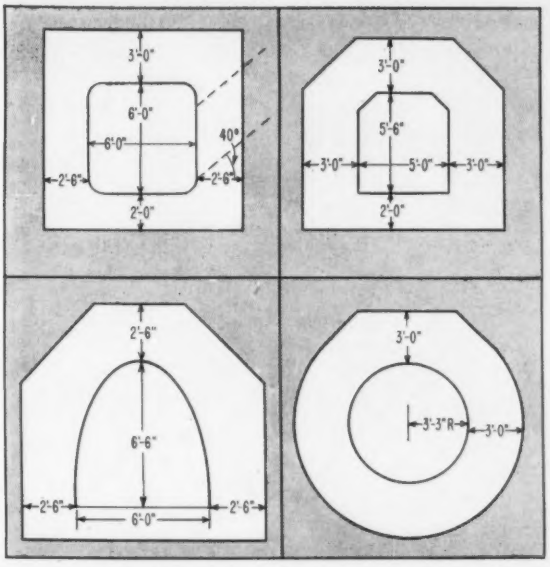
## Block Cave

Consequently in 1953 it was decided to install an experimental block cave section, the caving methods in America, particularly at the Johns-Manville and Climax mines, having been studied. This experimental section, comprising six drifts, was installed at Bultfontein. In less than two years it was proved that remarkably improved efficiencies could be obtained. It was therefore agreed that block caving on a large scale should be introduced at the Dutoitspan, Bultfontein and Jagersfontein mines.

The location of the block cave projects was largely determined by existing development, which had been carried out under the chambering system. Today Dutoitspan is partly under cave on the 1,350-ft level, but chambering will continue until 1962, when the entire mine will be block caved. At the Bultfontein Mine, chambering has stopped and undercutting has started on the 1,900-ft level. Details of the Dutoitspan and Bultfontein projects are shown in Table 2.

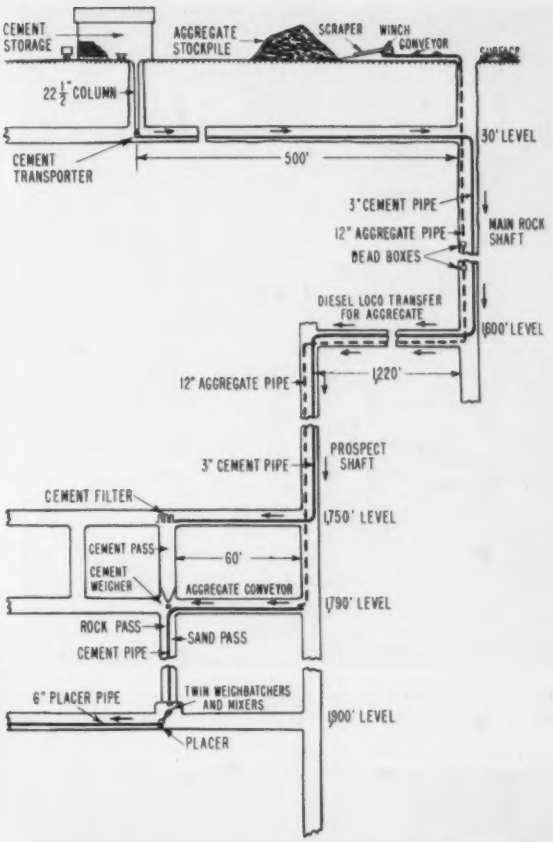
At Jagersfontein the changeover from chambering to block caving was begun in 1955 and was completed in 1958. During installation, the completed sections of block cave were brought into operation as soon as they were ready. The 1,870-ft level was chosen for the scraper drift level with the undercut on the 1,840-ft level. At the time, the lowest chambering level was on the 1,470-ft level, giving a back of 370 ft.

The block cave system has been used throughout the mine for over a year and it can now be said to be entirely satisfactory, though there was a period when conditions in the mine deteriorated badly because of block caving. By the time the whole block cave was nearing completion, the first section had "broken through" to the chambered area on the 1,470-ft level in the northeast part of the mine. The




**VARIOUS SHAPES** of scraper drifts were tried; the scoop jammed in the elliptical and was unsuited to the circular.

**A 6X6 FT DRIFT** permits the use of a large scoop, is the most easily repaired, and has proved to be the most suitable.




**CEMENT** is blown through a 3-in. pipe to the bulk storage pass. Rock and sand are lowered in 12-in. and 6-in. pipes.

removal of the solid ground in this portion of the pipe and the undercutting of three quarters of the entire pipe allowed the mass within the pipe to slide northeast and down. In addition to the mass of virgin blue between the 1,870-ft level and the 1,490-ft level, there was a great block of unpay ground, which extended right up to the 700-ft level. This mass also broke away and commenced to move downward.

The result was that all the workings in the mine and the surrounding rock, between the 900-ft and 1,950-ft levels, started to take weight and deteriorate. So serious was the position that even timbers in a shaft, 200 ft from the pipe, started to crush and the sidewall of the shaft to scale-off. Traveling ways up to 150 ft away from the pipe took weight. In the pipe the majority of drifts showed signs of weight and portions of nine drifts collapsed completely.

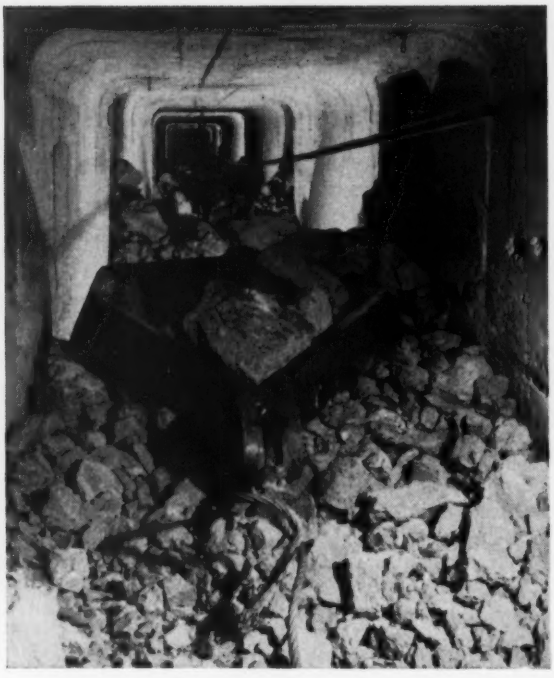
Fifty-three drawpoints were lost, of which 20 have been reclaimed, and it

**Table 3. Accepted Drift Standards**

| | |
|---|---|
| Shape | 6 x 6 ft inside |
| Concrete thickness Sides | 2 ft 6 in. |
| Roof | 3 ft |
| Floor | 2 ft |
| Drift centers (staggered) | |
| Drawpoints | |
| Concrete (Not reinforced. Normal hardening with calcium chloride and Lessopol.) | 4 : 2 : 1 |
| Shuttering | Collapsible steel |

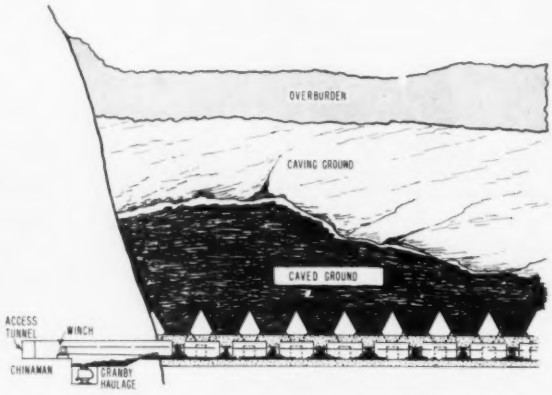
**Table 4. Comparisons of Mining Methods**

| | Open cast workings | Hoisting from 900-ft level | 1,350-ft level | 1,950-ft level | 1,950-ft level |
|---|---|---|---|---|---|
| Cost per ton washed | 3/2.8 d | 5/2 d | 8/4.4 d | 8/4 d | 7/9.5 d |
| Carats per 100 tons (Average) | 14.06 | 10.94 | 7.66 | 8.25 | 7.10 |
| European labor | 505 | 758 | 363 | 320 | 288 |
| African labor | 4,929 | 7,307 | 1,888 | 1,620 | 1,046 |
| | | | | Chambering & Block Cave | Block Cave |



**SCRAPER DRIFTS** extend across the pipe from the country rock on one side to the country rock on the other side. If the diameter of the pipe exceeds 300 ft, the length is halved and scraping is done from the center to the haulage at each end.

**CHAMBERING** productivity amounts to 6.4 tons per African shift; the block caving figure is 17 tons per African shift.




**HAULAGE DELAYS** are avoided by only filling cars from stockpiled drifts. Winch operator signals a train when ready.

is expected that the remaining 33 will ultimately be recovered. Today the subsidence of the ground within the pipe is not affecting the surrounding areas and conditions have been stabilized.

## Concreting of Scaper Drifts

In the experimental stage of block caving, various shapes of scraper drifts were tried. The elliptical drift is strong but the scoop tends to jam because of the decreased width when the scoop rides over the piles of ground at the drawpoints. The circular drift is difficult to repair and requires a circular scoop. A 6x6-ft drift permits the use of a large scoop, is most easily repaired and has proved to be the most suitable (see illustration).

The scraper drifts are first developed as 5x7-ft tunnels and are sliped* just ahead of the advancing concrete lining. Eight drifts are concreted at a time with two crews, each having four sets of 12-ft long shuttering. The procedure is to place concrete in one of the drifts, the first day, erect shuttering the second, slipe and clean the third and strip shutter the fourth. An advance of 11 ft 3 in. is thus obtained every fourth day in each scraper drift.

The concrete floor is always carried ahead of the shuttering, which is collapsed, moved forward and erected on the previously placed floor.

About 500 pockets of cement are used every day. It is blown pneumatically, in batches of ten pockets at a cost of 1d per pocket, through a 3-in. pipe to the bulk storage pass. The cement travels about 3,500 ft along horizontal cross-cuts and two vertical shafts.

Rock and sand are lowered in 12-in. and 6-in. pipes, respectively, to a partitioned storage pass of three day's capacity, located just above the mixing

* A slipe is a sled runner, placed from working breast to draw drift, forming tracks for the slusher.

plant. The rock pipe is kept full to save wear, while the sand is conveyed through an empty pipe.

In the mixing chamber there is a weighbatcher, two concrete mixers and two Pressweld pneumatic ½ cu yd concrete placers. The aggregate pass discharges rock and sand into the weighbatcher to be discharged into the mixers. Cement from the bulk storage pass is weighed and passed to the mixers in 6-in. pipes. These mixers are able to supply either placer with concrete, the output of each placer being 10 cu yd per hr. The concrete is blown pneumatically into the shuttering through 6-in. pipes. To ensure the quality of the concrete, daily compressive tests are carried out in the mine laboratory.

**BLUEGROUND** from Bultfontein and Dutoitspan mines is hauled to the tips at the joint shaft on the 1,900-ft level.

## Undercutting

Once the scraper drifts have been completed, undercutting is done in stages at the rate of 20 drawpoints per month. From each drawpoint a raise is put to within 7 ft of the undercut footwall. The final round is drilled as well as the coning holes, and these are left standing until after the undercut blast.

Tunnels, parallel and at right angles to the drifts, divide the undercut level into pillars 17x29 ft. Horizontal holes are drilled by means of flexible steel in rows of three holes at 2 ft 3 in. burden, and are blasted with millisecond delays. An area of 202x45 ft is undercut in a single blast. The previously drilled raises and coning holes are then blasted.

## Collection of Ground in Drifts

The drifts extend across the pipe from the country rock on the one side to the country rock on the other side. If the diameter of the pipe exceeds 300 ft, the length is halved and scraping is done from the center to the haulage at each end. The average scraping distance is 200 ft.

In all drifts the standardized equipment is as follows: 75 hp Joy Sullivan winch with 50 hp motor; a ¾ in. dia rope; 24 in. tail sheave; 2 ton v-back scoop; 6 in. dia tail rope snatchblocks and a 32 v, loco-type, sealed-beam drift light.

The floor section of the drifts in the country rock is developed 2 ft below the drift floor level in the blueground. This serves as a stockpiling area for about 15 tons.

When the winch operator has nearly filled his stockpile, he calls the train (granby cars drawn by a diesel loco) by means of a signal light. On arrival of the train he empties his stockpile, the ground falling through a chinaman box directly into the cars below. Once the train has moved to another drift, the winch operator refills his stockpile. Haulage delays are thus avoided by only filling cars from stockpiled drifts. By scraping into 6-ton cars it is possible to handle large lumps. This greatly reduces the amount of explosives used in secondary blasting and enables a winch operator to produce up to 250 tons per shift.

Draw control is strictly applied because of the danger of dilution by shale overburden in the pipes. The winch operator records the source of each scoop and the loco driver records the number of granby cars and the drifts from which they are filled. As the supply of broken ground in a drift becomes exhausted, the winch driver moves to another drift, while the miner blasts and bars down the drawpoints in the exhausted drift. In this way the daily production of ground is kept constant.

## Advantages of Block Caving

The labor requirements underground for both Dutoitspan and Bultfontein mines, when the change over to block caving is completed, will be 98 Europeans and 514 Africans. Under the chambering system 180 Europeans and 1,709 Africans were required. In these mines the actual mining cost per ton should be reduced from 6/- to 4/9d, a savings of 21%.

Other advantages of the block cave system include greater safety, the concentration of all workings on one level, improved security — since the hand loading of the ground is replaced by mechanical loading, easier supervision and improved ventilation. Too, grading of the different types of work is easier and allows for the grading of African labor; thus the right man is put in the right job.

Above all more ground can be produced per person underground per shift. Because the lumps of ground had to be broken manually in chambering in order to pass through a 12-in. grizzly into 16 cu ft cars, a loading boy could, at the most, load some 20 tons per shift. It has not been possible to employ mechanical methods of loading in the chambering system. Mechanical loaders and conveyors have been tried without success because ground conditions permit only small excavations to be made under this system.

It is estimated that on 4,800 tpd, productivity in tons per shift for underground labor with the mines on block caving will be 90 per European shift and 17 per African shift. With the mines on chambering the productivity is 60 tons per European shift and 6.4 tons per African shift.

## Hoisting

One of the most significant results of block caving at Dutoitspan and Bultfontein mines has been the centralization of hoisting at one shaft. Under chambering, the two mines operated completely independently. Each mine had its own hoisting shaft and boiler plant for the operation of steam hoists and compressors.

With the application of block cave methods, this is no longer necessary, due to decreased labor and material requirements. Today the ground from both Dutoitspan and Bultfontein is hoisted up the Bultfontein shaft. This will result in a saving of £112,000 per annum when both mines are operating concurrently.

In order to achieve this centralization, a tunnel, 2,200-ft long, had to be driven from the pipe at Dutoitspan to the hoisting shaft at Bultfontein on the 1,900-ft level. This tunnel was com-

pleted in August 1957, just four months after it was begun.

Three conveyor belts were installed at Dutoitspan to deliver the ground from the peripheral passes to the central pass, down which the ground is tipped to the 1,900-ft level. The conveyors replaced the endless rope haulage previously used and reduced the number of Africans required from 105 to 49.

On the 1,900-ft level, a 30 in. gage overhead electric haulage with 6-ton granby cars was installed. The ground from both mines is thus hauled to the tips at the joint shaft.

At the joint shaft the ground passes through a 48x42 in. Allis Chalmers jaw crusher of 6-in. setting. This crusher was installed to handle large lumps mined under block cave and is capable of crushing 330 tons per hour at 6-in. setting. A Dualaire filtering plant at the crusher handles 25,000 cfm, and collects approximately half a ton of dry dust per hour. The quantity of dust has been reduced to this amount by the use of Compound MS, a wetting agent.

The Bultfontein shaft had to be completely renovated so that the increased tonnage of 12,000 tons could be hoisted. All the timber in the shaft was replaced by steel. In the skipways the bunton-ends were secured in continuous concrete strips, while in the manways they were concreted into "cousinjack" hitches which had been grouted and bolted to the sidewalls.

The steam plants at both mines were shut down. At Bultfontein mine a 4,040 hp, double drum, electric hoist with 13-ton bottom dump skips was installed. The Man Engine at this mine was converted to electric operation and a small electric hoist, to be used in emergencies only, was installed at Dutoitspan.

By using a joint shaft, only one office block, change house and new engineering workshop are needed to serve both mines. When both Bultfontein and Dutoitspan are producing, the combined economy of caving, the joint shaft and the centralization of operations will be at least £300,000 per annum.

At Jagersfontein the collection of ground is carried out on the 2,020-ft level, from where it is conveyed to the 1,950-ft level on an inclined conveyor. Hoisting is from the 1,950-ft level. The present hoisting engine was erected in 1910. This engine is reputed to have created the world's hoisting record of one hundred 10-ton skips per hr for 10 hr from the 900-ft level in 1912.

## Treatment Plant

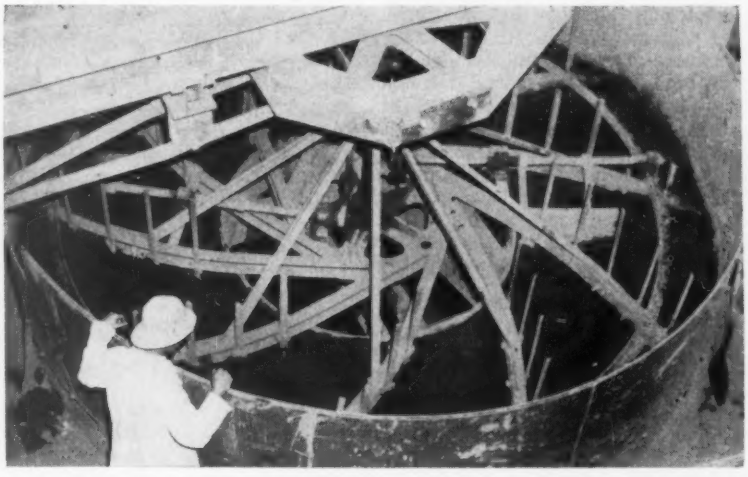
Having mined the blueground, it is necessary to process it in order to recover the diamonds. The early diggers merely pulverized it as best they could with clubs, mallets and shovels. They sifted this pulverized material in rocking troughs fitted with sieves and then dry sorted the gravel for diamonds. The first major step towards improved recovery methods was the introduction of water in the concentrating process and the evolution of the Rotary Washing Pan from 1874. The principle of the first rotary pan is the basis of the concentration methods used today. (See the above illustration for a process explanation.)

Once the blueground (minus 12-in.) has been brought to the surface, it is screened, hand sorted for the removal of waste rock and crushed in closed circuit crushing to minus 1¼-in. It is then sent to the treatment plant for concentration. Prior to 1924 and the invention of improved crushing machinery, the blueground was laid out over large areas, called floors, to weather and break down sufficiently enough to wash.

At Kimberley the treatment plant is a central plant and handles the ground from all three mines. It is designed to treat a maximum of 1,000 tons of blueground per hour. The ground is brought to the plant by conveyor belt from the Bultfontein and Wesselton mines. It is received into a feed control bin from where it is distributed to the washing section in the required quantity, or is sent to the stockpile for reclamation later. Both the control bin and the stockpile are so arranged that bulk samples of blueground may be separated in order to test the grade of any selected mine.

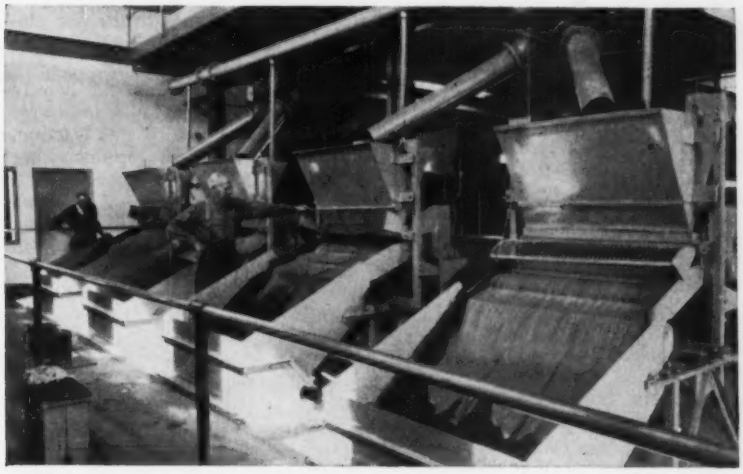
In the washing section two 100-ton bins receive the ground from the control bin. From these two bins the

**TREATMENT PLANT** at Kimberly handles a maximum of 1,000 tph of blueground from all three mines. Conveyors transport the ore from Bultfontein and Wesselton.



**THE TEETH** of the rakes in the washing pan slowly move heavier, settled material to the outer rim, where it is continuously extracted. Puddle has sp g of 1.29.

**TAILINGS** are disposed in two ways: excess puddle is pumped to slimes dams for water reclamation; and coarse material deposited by a belt conveyor and flinger.



**DIAMONDS** are collected on grease tables and removed by scraping the table and placing the mixture in boiling water. Reduction is approximately 20 million to 1.

ground is equally distributed to the twelve pan sections of the plant, where it is mixed with a washing medium of muddy water, called puddle, and continuously fed into the primary rotary pans for concentrating.

## Primary Pans

The primary pans are flat, annular vessels with a 14-ft external, and a 6-ft internal, dia. They are 15-in. deep and within them revolve rakes with vertical triangular shaped teeth, the teeth being set in a spiral working outwards. The minus 1¼-in. blueground is mixed with the puddle, which has a specific gravity of 1.29, and is fed into the outer rim of the pan. The revolving rakes keep the mass in a state of suspension, allowing the heavier minerals to settle to the bottom of the pan. Of the heavy minerals, the diamond, with a specific gravity of 3.5 is the heaviest. The teeth of the rakes slowly move this heavier, settled material to the outer rim of the pan, from where it is continuously extracted. The concentrate of heavy material comprises only 1% of the incoming feed.

The lighter mass, revolving in the pan, escapes over a weir in the inner ring and passes over ⅜-in. rod deck screens. Oversize is sent by conveyor belt to the re-crush section, where the minus 1¼-in. plus ⅜-in. material is reduced in closed circuit crushing to minus ⅜-in. for the release of small diamonds. Minus ⅜-in. material joins the feed from the two 100-ton bins, and so passes once again through the primary pans and screens, and on to the secondary pans with the other material escaping over the weirs in the primary pans.

**Table 5. Comparison of Transportation Methods**

| | Endless rope haulage | Conveyor system |
|---|---|---|
| European labor | 7 | 1 |
| African labor | 88 | 12 |
| Cost per ton washed | 4.6 d | 1.8 d |
| Capital cost | £20,000 | £33,700 |

## Secondary Pans

In the secondary pans the principle of separation is the same as in the primary pans. From them a further 1% of the feed is continuously extracted as concentrates. This 1% joins the 1% concentrate, obtained from the primary pans, on a conveyor for delivery to the recovery plant.

The entire operation of "washing" the ground to this stage is controlled from two panels, operated by one man by means of remotely-controlled comet belt feeders and hydraulic valves. In the previous plant, which was not equipped with centralized control, six men were required for this same purpose.

Control of the pans is effected by increasing or decreasing the amount of water to each pan and so keeping the specific gravity of the puddle in the pans consistent. Indicators on the panels give the operator a complete picture of the quantity of ground in the bins, the amount of puddle in the tank available for distribution and the opening of each water valve. Push-button alarms and lights indicate to remote operators the requirements of the control room operator, who is also able to bring the whole, or parts, of the plant to a complete halt in an emergency.

The lighter constituents of the blueground that escape over the inner weir of the secondary pans are passed over ⅛-in. screens. Material larger than ⅛-in. is delivered to conveyor belts for disposal as tailings. Minus ⅛-in. is pumped through wet cyclones. Concentrate from these cyclones passes through tertiary pans for the recovery of fine diamonds.

Cyclone overflow constitutes the puddle, which is used throughout the plant as a washing medium. Tailings of the tertiary pans go to rake classifiers. The rake discharge joins the tailings from the secondary pans and the overflow of the classifier goes to a thickener for the recovery of water, which, together with additional water, is used in the control of the density in the pans.

Tailings are disposed in two ways: excess puddle is pumped to slimes dams for reclamation of water, and coarse tailings are conveyed to a series

of flingers and deposited onto a tailings dump.

The treatment plant at Kimberley, costing £1.4-million and capable of treating 20,000 tpd, was completed early in 1958, exactly 10½ months after construction commenced. It replaced the old plant built in 1924.

The new treatment plant was justified on the following grounds:

**(a)** Its central situation made it possible for the ore to be brought by conveyor belts rather than the previous system of 1-ton cars, drawn by an endless rope haulage. This arrangement has resulted in a substantial saving in labor of 16 Europeans and 170 Africans. It is interesting to note that on the one haulage, between Bultfontein mine and the plant, a saving of approximately £3,000 per month has been effected since the changeover from endless rope haulages to conveyor belts.

**(b)** In the plant the following reductions in labor have been and will be possible:

| | | |
|---|---|---|
| 1951 | — 71 Europeans | 647 Africans |
| 1958 | — 46 Europeans | 550 Africans |
| 1960 | — 37 Europeans | 450 Africans (estimated) |

**(c)** The increased capacity of the new plant will enable larger tonnages to be treated. This is particularly advantageous in view of the decreasing grade at depth in the mines.

**(d)** Improved recovery has resulted from the incorporation of the tertiary recovery circuit, in addition to the primary and secondary screens. The increase in production has been over 10,000 carats per month, although admittedly of an inferior quality of diamond. Another contributory factor to improved recovery has been the adoption of a method of continuous extraction from the pans in place of the previous intermittent method.

Jagersfontein Mine has its own treatment plant, which is capable of treating 1,692,000 tpy. Here, too, the tailings are disposed of by conveyor belts and flingers in place of the old method of one-ton cars and endless rope haulages. A comparison of the two methods (Table 5) shows that a saving of £14,350 per annum is made with the use of conveyors.

## Recovery Plant

The concentrates from the treatment plant are delivered to the recovery plant for the final extraction of the diamonds. Until the invention of the first grease table in 1897, the concentrates from the washing pans had to be reconcentrated by jigs and hand sorted for diamonds.

At Kimberley, the final recovery of the diamonds from the concentrate was carried out at the "Pulsator" from 1907 until 1952. When built in 1907, the Pulsator was centrally situated in relation to the five operating mines, the Kimberley and De Beers mines then still being in operation. Each mine had its own depositing floors and washing plant, from where the concentrates were conveyed to the Pulsator in ½-ton cars, hauled on an 18-in. gage railway by steam locomotives.

The Pulsator comprised six sections, four of which treated the blueground concentrates from the washing plants in a single shift each day. The fifth and sixth sections were for lay-off maintenance and test purposes.

On arrival at the Pulsator the concentrates were elevated by 6-in. bucket elevators and closely sized by trommels into seven sizes, ranging from minus 1/16 in. plus 0, to minus 1¼ in. plus ⅝ in. Each size was treated in a Harz Pulsator Jig, there being 40 double compartment 1 ft 9 in. x 6 ft 6 in. jigs in the plant. The 25% concentrate obtained from the jigs was elevated in 4-in. bucket elevators to side shaking grease tables, on which the diamonds were recovered. There were 51 of these grease tables, each being 2 ft 3 in. wide and 13 ft long.

Although efficient, the Pulsator was expensive to operate and maintain. Too, it became inconveniently situated when the De Beers and Kimberley mines closed down and the depositing floors were replaced by crushing plants situated at the shaft collars of the mines, and when the washing operations were centralized at the old treatment plant.

In 1952 it was decided to build a modern recovery plant adjacent to the old treatment plant. This plant was moved to the new treatment plant site in 1958 and several innovations made.

The present recovery plant is divided into two sections: the main recovery plant which is completely separate from the treatment plant, and the fine diamond section which is integrated with the treatment plant.

## Fine Diamond Section

The fine diamond section consists of seven 2-ft 6-in. x 5-ft electromagnetic vibrating screens with 28-mesh stainless steel screen cloth. Each of the screens is followed by two vibrating grease tables. Concentrates from the tertiary pans, being minus 6-mesh material, are washed on six screens and are treated for diamond recovery on 12 of the grease tables. Tailings from the tables, after dewatering in two 4-ft Akins classifiers, are led to the treatment plant tailings conveyor. This section operates on two shifts and treats 200 tpd.

Four hundred tons of minus 1¼-in. plus 0-in. concentrates, from the primary and secondary pans in the treatment plant, are collected daily over two shifts on 30-in. deep troughing conveyors. They are then washed on two 3x6-ft x 10-mesh vibrating screens. Undersize of the screens is pumped to the fine diamond section, where it is treated on the remaining wash screen and two grease tables.

Oversize of the wash screens is conveyed to three 120-ton bins in the recovery plant. This plant operates on one shift only, during which 320 tons of plus 10-mesh concentrates are treated at the rate of 45 tons dry weight per hr.

## Heavy Media Separation Cone

From the 120-ton bins, the concentrates are elevated by an 18-in. inclined conveyor to a 5 x 10-ft x 10-mesh wash screen, ahead of the Heavy Media Separation cone. Undersize of this screen is pumped to the fine diamond section for treatment, while the oversize is led to a 7-ft cone.

The cone, operating at 2.8 density medium, and using 65D ground ferrosilicon, produces a 20% sink fraction. The sink and float products are drained and washed on one 2x10-ft, and one 3x14-ft, 10-mesh vibrating screen respectively. Medium return to the cone is by a 3-in. metal-lined pump and ferro-silicon is recovered by a 24-in. belt electro-magnetic separator.

The sink fraction is elevated by an 8-in. bucket elevator to two 10-ton surge bins. From the bins it is again elevated by an 8-in. bucket elevator to a 3x6-ft sizing screen, where it is separated into three sizes: minus 1¼-in. plus ⅞ in.; minus ⅞ in. plus ⅜ in.; and minus ⅜ in. plus 10 mesh.

The first size is fed to a 2-ft 3-in. x 6-ft 6-in. side-shaking grease table and the other two sizes to a vibrating grease table. Two supplementary grease tables for the minus ⅞ in. plus ⅜ in. and minus ⅜ in. plus 10 mesh are provided to allow for the removal of the diamonds and the redressing of the grease surface.

Once the grease has been scraped off the tables, the diamonds are removed by boiling it in water and are cleaned prior to being delivered to the Diamond Producers Assn. for sorting and valuation.

The daily production of diamonds amounts to 2,800 carats (1.25 lb) from 13,000 tons of ore mined and treated, a reduction of approximately 20 million to 1.

The recovery plant has effected a reduction over the Pulsator complement of 32 to 11 in skilled and unskilled European labor, and 80 to 22 in African labor. The working costs have been reduced by 50%.

**ED EISENACH,** Climax' resident manager (left), and Robert Henderson, general superintendent of the western division, plan travel schedules for greatest efficiency. Mt. Bartlett and Climax plant sprawl at top of Colorado's Fremont Pass.

# Climax Plane Trims Time and Costs

**CLIMAX** Commander takes off from 10,000 ft elevation strip at Leadville, Colo. Plane can seat up to seven passengers.

**CLIMAX PLANE** on the Leadville strip after a full day of transporting executives and engineers to branch operations.

CLIMAX MOLYBDENUM CORP. is putting its company plane to use in solving transportation problems on tight schedules. The airplane, a seven-place twin-engine Aero Commander, was purchased by the company several years ago. According to Frank Coolbaugh, Climax president, "By using a company plane we experience economy, speed and convenience in expediting executive travel."

President Coolbaugh and his staff make continued use of the airplane throughout the year. Most flights are made at altitudes of 16,000 to 20,000 ft. Many trips terminate at short landing strips in isolated areas or high elevations such as the 10,000-ft high strip at Leadville, Colo.

According to Mr. Coolbaugh, many trips "would have been an impossibility without benefit of the plane." The airplane provides on-the-spot service.

On one occassion, pilot R. C. Potter took the twin-engine company plane from Denver with a geologist destined for Grants, N.M., and the company financial manager headed for a visit at a New Mexico mining operation. The plane flew to Grand Junction, Colo., to pick up a mining engineer going to the same New Mexico operation.

The group flew to the New Mexico campsite-landing strip (3,000 ft long and 6,000 ft above sea level) to drop off the financial manager and mining engineer and then on to Grants to drop off the geologist. After lunch, the pilot flew back to the New Mexico strip for the manager and engineer. Mr. Potter left the engineer at Grand Junction, Colo., and returned to Denver with the mining executive.

There are no scheduled flights into Grants, and ground travel time by scheduled carrier would have far exceeded the working hours utilized during the day. "No possible commercial carrier scheduled could have enabled the men to accomplish their mission in one day's time," said Robert Henderson, general superintendent of the company's western division.

Ed Eisenach, resident manager added, "We measure the worth of our airplane like we do any tool of business. It is considered a piece of company equipment just as our mining machinery, IBM equipment or a typewriter."

### *An Invitation to Mining Companies*

THE GOVERNMENT OF SURINAM extends a cordial invitation to mining companies interested in developing the natural resources of the land. As part of a broad Ten-Year Development Program, special efforts have been made to facilitate exploration and development of mineral resources in the untapped southern portion of Surinam which comprises some 80% of the total area of the country. Under various Government agencies, land and aerial transportation systems, geological and mining services, and, more recently, aerial magnetic and radiometric surveys are being expanded or completed to assist mining and exploration engineers in ascertaining the location and extent of mineral deposits. The success of mining companies already operating in Surinam is indicative of the equitable mining agreements which the Government is prepared to negotiate with parties interested in developing potential mineral resources.

**Dr. Ir F. E. Essed**
**Minister of Development**

# Surinam's Ten-Year Development Program

"SURINAM IS NOT AN UNDERDEVELOPED NATION—It is a nation under development." Inherent in this guiding concept of the country's current ambitious Ten-Year Development Plan is the pride, determination and energy of a new nation seeking to improve its economic and social status.

Although in Latin America, Surinam is not at all Latin in character. Dutch and English are spoken widely. Its heterogenous population contributes characteristics and aptitudes from Europe, Africa, India, Indonesia, China and Pre-Columbian America. Even though the country flanks the Equator, its people exhibit a marked degree of industry and energy. The way the Surinamese flit up and down the streets of Paramaribo on bikes and motor-bikes, a visitor will do well to look both ways before crossing even a side street.

It is a true democracy—exemplary for the degree of religious tolerance and equality of people of many global origins in evidence in Surinam. Other pertinent information on Surinam is presented in the accompanying table of facts in brief.

## A Unique Formula of Development

Surinam's plan to develop its interior will warrant international attention because its program to open up a heretofore impenetrable jungle frontier is bold, unique and resorts to the most modern devices and techniques available to man. Speed and progress which are so vital to the plans of great masses now straining everywhere to find improved living room are essential targets of Surinam's exemplary program. To mining men, the great emphasis placed on mineral development with modern techniques will be of specific interest.

## The Ten-Year Development Plan

The Ten-Year Development Plan grew out of recommendations of a mission of the International Bank for Reconstruction and Development in 1952. "Operations Grasshopper," of direct interest to mining readers, is part of the over-all plan, and will be described in the second part of this article.

In 1954 the Ten-Year Plan as drawn up by the Surinam Planning Bureau was accepted. In 1955 execution of the Plan which involved expenditures of Sf/127-million was started. One third of the total was financed by the Surinam Government, one third loaned by the Netherlands Government for a period of 25 years, and one third granted by the Netherlands Government. The TYP now in its sixth year has, of course, undergone revision and refinement to facilitate its execution.

## Objectives of the Plan

The economic and social status of Surinam is now being advanced through carefully conceived and balanced objectives in these major segments of activity: agriculture, forestry, industry, mining, aerial photogrammetry, transport, general provisions and public utilities, welfare service, public housing, people's credit service, technical assistance, improvement in Government administration, provision of labor, justice, and administration of the TYP.

Diversification to produce a balanced economy is a major objective of the TYP. The bauxite mining industry, for instance, has been a mainstay of the economy, accounting for one-third of the national product, one-third of direct taxes, one-half of total taxes, and 80% of the exports. And much as this contribution is appreciated, the TYP is striving, nevertheless, to push development of other industries and resources to enable the country to withstand occasional slumps in the aluminum and bauxite industry.

**THE OLD.** Slow, arduous penetration of the jungle by river boats soon dictated mineral exploration by the airplane.

**THE NEW.** Ground crew at airfield near Taffelberg—part of the bold development plan called "Operations Grasshopper."

## What TYP Has Accomplished

Statistically, Surinam shows steady growth since TYP was started in 1954 in the fields of agriculture, forestry, mining, industry, trade and transportation, services, and in government.

Its cross-country highway system is progressing nicely. The network of access air fields which open up the rain-forested interior is proceeding on schedule. A wealth of maps is readily available at the Central Bureau of Aerial Survey for parties interested in studying and planning development of Surinam's resources. The combined services, maps, reports and assistance of the Geological and Mining Service, Operations Grasshopper, and the Government Planning Office will give exploration companies a springboard not often available in undeveloped areas.

If population growth is indicative of improving economic climate, Surinam can boast of its fast-growing population which is increasing at the rate of about 4% per year. Here is an adequate human resource essential for the establishment of new industries and the opening of Surinam's beckoning jungle frontier.

Power resource development is also an important part of Surinam's development plans. Under a joint agreement between Surinam Aluminum Co. and the government, a dam and power plant with 150,000-kw capacity will be erected on the Surinam River, 60 miles south of Paramaribo. In addition, the Government's Brokopondo Bureau has set targets for the development of hydropower for periods as far ahead as 1985. The hydropower estimates and plans are based upon an engineering survey by a U.S. firm specializing in this work.

*(Continued on page 106)*

## *Facts in Brief About Surinam*

**Size:** 55,167 square miles.

**Population:** 238,000 composed of 90,000 Creoles, 73,000 Hindustani, 40,000 Indonesians, 22,000 Bush-Negroes (Djukas), 3,700 Amer-Indians, 3,000 Chinese, 3,300 Europeans and 3,000 others.

**Location:** Between 6° and 2° North latitude, and 54° and 58° West longitude, on the north coast of South America.

**Capital:** Paramaribo (Pronounced Paar - a - maar' - ee - bo) with a population of 100,000 inhabitants.

**Language:** The official language is Dutch, but nearly all people in business, industry, government, stores, taxis, clubs and hotels speak English. A native dialect, taki-taki, can be heard in the towns and, with some variations, in the Bush-Negro villages.

**Climate:** Annual mean temperature is 80° F. Warmest month, September, 83°; coolest month, January, 78°. Variations in temperature between day and night are greater than the annual range. During the night, temperature often drops below 70°. Annual rainfall, 90 in. Rainiest months: April, May, June, July, December, January. Driest months: September, October, November.

**Currency:** The currency is the Surinam Guilder or Florin (Sf) of 100 cents. The exchange rate is approximately Sf1.86 per U.S. dollar.

**Consulate of the U.S.:** Noorderkerstraat 3, Paramaribo.

**Principal Industries:** Value of national product for principal industries in millions of Sf for 1957 was as follows:

| | |
|---|---|
| **Agriculture** | 17.1 |
| **Forestry** | 3.3 |
| **Mining** | 48.7 |
| **Industry** | 15.9 |
| **Trade and Transportation** | 16.7 |
| **Services** | 13.1 |

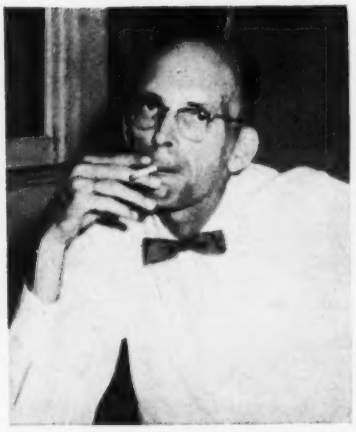
**Mining:** In 1958, Surinam was the third largest producer of bauxite in the world with total output of 2.94-million tons. However, the bauxite of Surinam is of premium grade and is purchased by some major aluminum companies to sweeten up the lower grades less amenable to processing. The two major producers are:

N. V. Billiton Maatschappij Surinam with operating concessions and processing plant situated west of Parinam, on the Surinam River. Bauxite is mined at the Billiton properties by hydraulic monitor, dragline and digging wheel.

Surinam Aluminum Co. with mining concessions at Rorac, in the Paranam area and Moengo; and processing plants at Moengo and Paranam. In 1958 Suralco signed a 75-year joint agreement with the Government of Surinam for the erection of a dam and power plant on the Surinam River, at Brokopondo, 60 miles south of Paramaribo. The 150,000 kw generated will be used in a reduction plant to produce some 50,000 metric tons of aluminum per year by 1965.

**W. J. J. Snijders,** Deputy Director of Development, largely responsible for the concept of Operations Grasshopper.

**C. van Kooten,** head of Geological and Mining Service organized to promote development of mineral wealth.



**H. R. Massink,** head of Central Bureau for Aerial Survey which provides excellent maps for the development program.

**H. Teunissen,** Director of the Brokopondo Bureau, now planning Surinam's power resources for many decades.

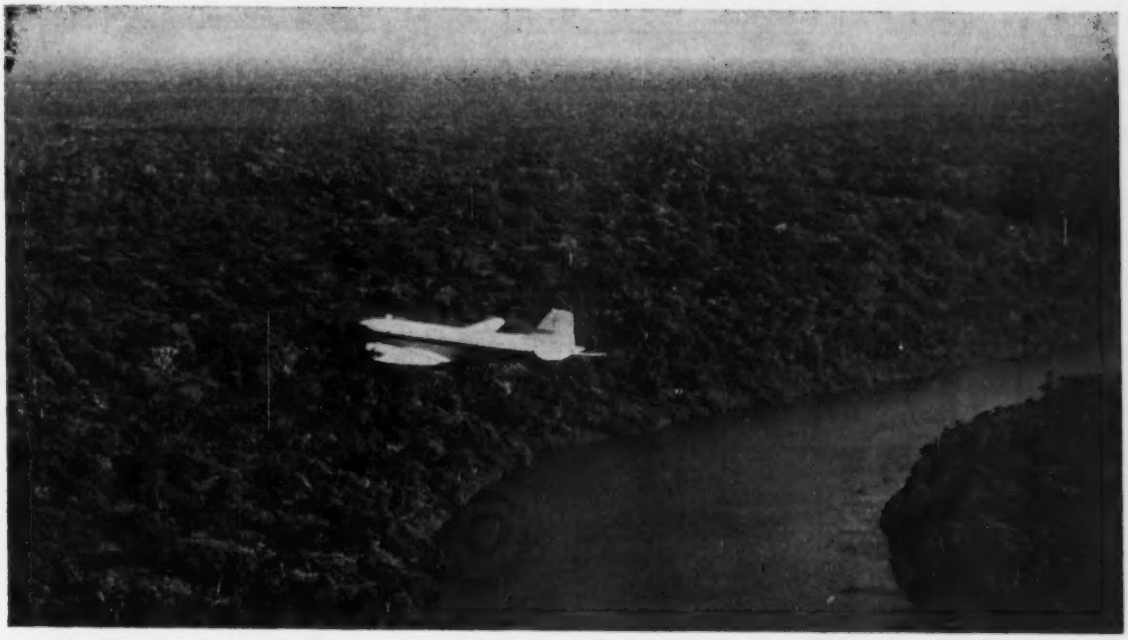
**Th. J. van der Peyl,** director of Surinam Planning Office (right), and B. E. Scheltema, office associate.

**W. G. Joseph,** head of Bureau of Information beside map of Surinam showing distribution of airfields in country.

**Leon Meadows,** pilot of the jungle-hopping tri-motor Northrop C 125, dependable workhorse of Operations Grasshopper. Beside him is his mechanic Jose Marin.

## Acknowledgments

The foregoing brief account of Surinam's TYP does not do full justice to its aims and accomplishments. However adequate documentation of this effort is available at the Government offices for interested parties. In summarizing this profile, E&MJ wishes to express admiration for the talented engineers and experts participating in all phases of the TYP, and for the enthusiasm which all of them have for the growth and betterment of the nation. Some of the key men participating in the program are pictured in this article. With this acknowledgment goes our expression of thanks to the many participants in TYP and Operations Grasshopper who gave liberally of their time to explain and reveal the objectives of Surinam's exciting development program.



**A LONE PLANE,** equipped with magnetometer and scintillation counter flies across Surinam's vast rain forest, guided unerringly by the electronic Doppler system, searches for tomorrow's mineral wealth. Results are illustrated on page 110.

# Operations Grasshopper Opens Up Surinam's Untapped Mineral Frontier

DURING THE BRIEF SIX-MONTH PERIOD, July 1959 to January 1960, a largely impenetrable jungle area comprising about 80% of Surinam's total 55,143 square-mile expanse was surveyed by airborne magnetometer and scintillation counter along flight lines totaling approximately 66,000 miles. The incredible speed and precision of this survey depended in part upon the most modern exploration tools available to man, including the magnetometer, scintillation counter, and the Doppler navigation system which guided the plane unerringly on predetermined flight lines over a vast tropical rain forest, often as devoid of identifiable benchmarks as the desert and sea.

For the benefit of mining companies actively seeking to develop mineral resources, 110 magnetic contour maps have already been prepared for the Government of Surinam and will be available for examination in Surinam and at the Consulates of the Netherlands in the U.S., Canada and elsewhere. An additional 154 maps will be completed by the end of September.

Here in part is an account of why and how Operations Grasshopper was conceived and implemented as part of Surinam's dynamic Ten-Year Development Plan previously outlined. Reference to the preliminary geological map of Surinam, page 108, will clarify the strategy of the mineral development program.

Note for instance that Surinam is divided into these broad geologic provinces:

| Geologic Province | Area in Sq Km |
|---|---|
| Young coastal plain (Demara Series) | 16,000 |
| Old coastal plain (Coropina Series) | 4,300 |
| Savannah zone (Zanderij Series) | 10,000 |
| Guiana Shield (Remaining area to the South) | 112,700 |
| Total area | 143,000 |

Of this total, approximately 112,000 sq km will be dependent upon Operations Grasshopper for exploration and development.

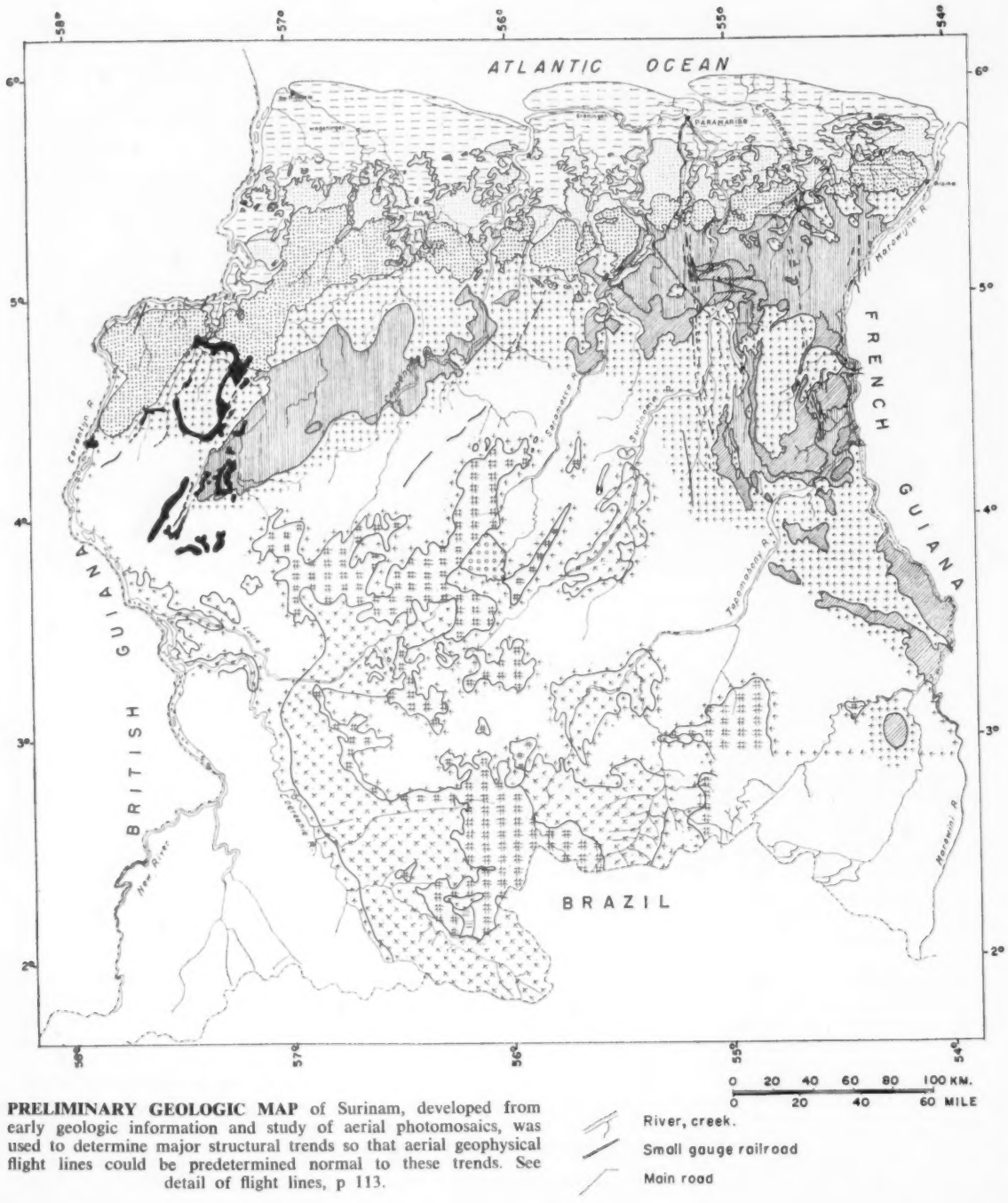
During the early days of the Ten-Year Plan, geologists and exploration engineers penetrating the rain forest area, roughly below the 5° parallel, had to travel by corjal (see illustration) on main streams and tributaries to the limit of navigability. Exploration was possible but difficult approximately 20 to 25 km beyond points which could be reached by corjal. Exploration beyond these points involved a loss of 50 to 60% in time for travel and carrying loads. For example, in 1957 field work started at Bakhuis Mt., which is 168 km south of Niew Nickerie and only 80 km from the coast, had to be suspended after two field seasons because too many working days had been required for transportation.

So it became obvious, that if the mineral development phase of the Plan were to succeed, bold new steps would have to be taken to:

1. Solve the difficult transportation problem, and
2. Adopt geophysical methods that would pin-point attractive areas for future exploration.

Thus Operations Grasshopper was conceived, calling for an expenditure of approximately Sf22-million during the 1959-66 period.

The plan envisions seven air strips eventually capable of accommodating Douglas DC3 aircraft with a three-




**PRELIMINARY GEOLOGIC MAP** of Surinam, developed from early geologic information and study of aerial photomosaics, was used to determine major structural trends so that aerial geophysical flight lines could be predetermined normal to these trends. See detail of flight lines, p 113.

ton payload. These will be located at the following strategic hubs (see map):

1. Table Mt.
2. On a savannah near the source of the Sepaliaini River in the deep south of Surinam.
3. In the narrow area between the Lucie and Coeroeni rivers.
4. On a small savannah west of Eilerts de Haan Mt.
5. Near the confluence of the Paloemen and upper Tapamahony rivers.
6. Near the Oelemari River east of Orange Mt.
7. In the northern parts of Bakuis Mt.

Distance between these airfields is roughly 80 to 100 miles. The DC3 strips consist of a 30-meter runway, 1,500 meters long, flanked by 30-meter wide cleared zones. Approach areas to the runways are cleared to permit a 1:20 glide, and flared 5° laterally from the four corners of the field. The axis of each field is oriented to take advantage of prevailing winds.

In some fields as the Coeroeni River, dense jungle growth had to be cleared and uprooted by hand, then graded and tamped firm with tools brought in by small river craft. At others near savannahs, small aircraft brought in tools and supplies to start construction.

Geologisch Mijnbouwkundige Dienst
(Surinam Government Geological & Mining Service)

## GEOLOGICAL SKETCH-MAP OF SURINAM

| | | | |
|---|---|---|---|
| | DEMERARA | Marine clays (some with organic material) to (shell) sands. And most of the alluvial river and creek deposits | Quarternary |
| | COROPINA | Marine and brackish clays (some with organic material) to fine sands. And some of the alluvial river deposits. | |
| | ZANDERIJ | Continental (probably partly also marine) coarse sands (and some gravels) to clays. | |
| | | | Upper Tertiary? |
| | YOUNGER DOLERITE | Gabbros, dolerites, basalts. | Post-Roraima Post-Granite 3b (Mesozoic?) |
| | RORAIMA | (Quartzitic) sandstones, conglomerates and tuffs. | Lower Palaeozoic or Upper Precambrian? |
| | GRANITE 3b | Bi-mica microcline granites. | Post-Roraima? |
| | GRANITE 3a | Mostly para granodioritic gneisses. | Post-Rosebel |
| | GRANITE 2 | Mostly quartzdiorite(s) (gneisses). Migmatized rock included. | Post-Balling also Post-Bonnidoro? |
| | GRANITE 1? (inferred) | ? | Theoretically: Pre-Bonnidoro Post-Balling |
| | ROSEBEL | (Mostly low grade) metamorphic pelitic to psefitic sediments. | Precambrian |
| | BONNIDORO | (Mostly low to medium grade) metamorphic pelitic to psefitic (sometimes mostly psammitic) sediments. With (meta) rhyolites. | |
| | BALLING — NASSAU | Mostly (low to medium grade) metamorphic basic lavas. With some (low to medium grade) metamorphic acid lavas, tuffs, agglomerates and sediments. Incidentally with partly metamorphosed basic to ultrabasic rocks. | |
| | BALLING — PARAMAKKA | Striking variety of (mostly low to medium grade) metamorphic volcanic rocks and pelitic to psammitic sediments. | |
| | PRIMEVAL BASEMENT | Inferred: Ortho and para gneisses, quartzites, ortho and para amfibolites, migmatites. | |

Preliminary photogeological analysis.
Compiled by Aero Service Corp.

- Ortho and para granitegneisses
- Wilhelmina Mnt. type landscape
- Flat granite landscape
- Metamorphosed sediments

For the benefit of non-geologist readers, definitions of some of the terms used above are as follows:

Agglomerate: A breccia composed largely or wholly of fragments of volcanic rocks.

Dolerite: A coarsely crystalline basalt.

Migmatites: Mixed sedimentary and igneous material possibly produced by injection metamorphism.

Pelitic: Sedimentary rock formed of clay.

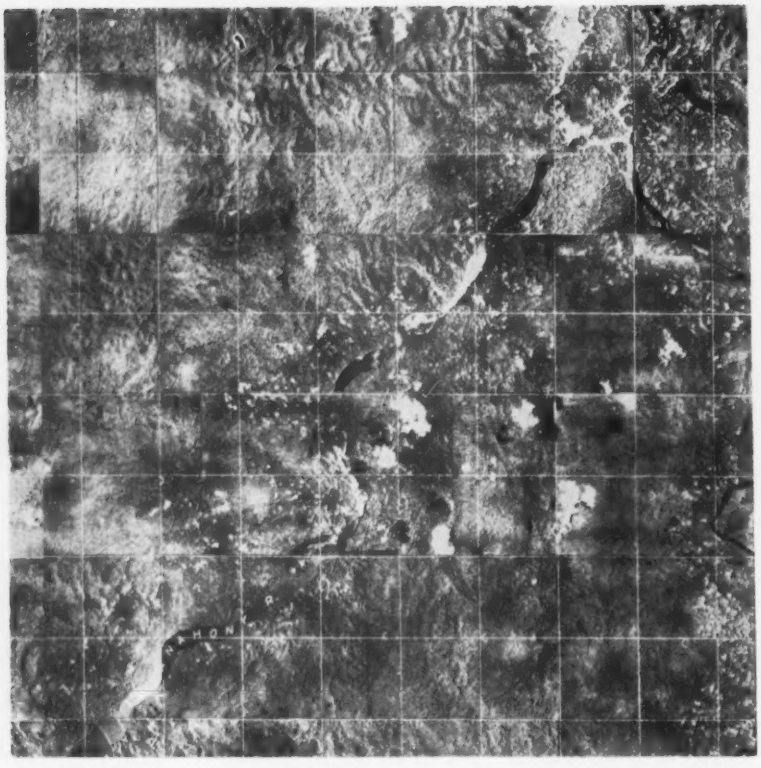
Psammitic: Made up of particles the size of sand.

Psefitic: Made up of small stones. Conglomeritic.

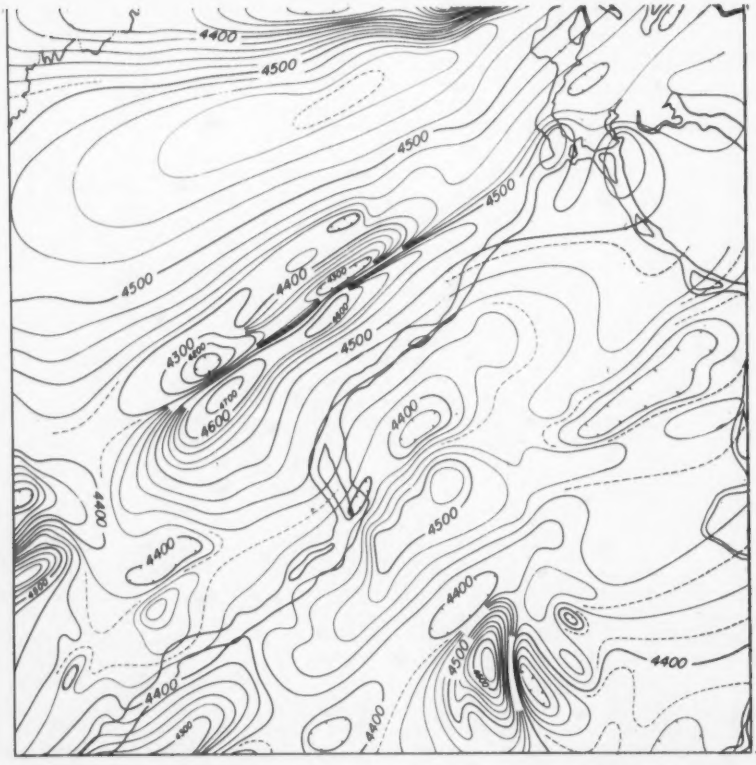
Accommodations at each airstrip include fueling stations, repair and maintenance shops, radio equipment and camp buildings.

Safe operations of the airfields and transportation system are maintained through the cooperation of the Geological Department; Public Works Ministry, which constructed the airfields; Surinam Aviation Co., which provides transportation; Civil Aeronautics Administration which regulates transportation; and meteorological services provided by the Agricultural Experimental Station.

After consideration of various types of heavy transport planes for the initial airlift phase of the program including the helicopter, a unique aircraft used by the U.S. Air Force for heavy landings on undeveloped fields, was selected for Operations Grasshopper. This plane, a Northrop C125 (see photos) can land and stop fully loaded with a 15,000 lb payload in 500 ft. It has a 1,800-mile operating range. Air speed is 150 mph. It is powered by three 1,350-hp Wright engines. With this unique extensible flap construction, the plane can climb and drop at a 30° angle—a very comfortable margin for airfields ringed by trees that may exceed 150 ft in height. This remarkable air workhorse has functioned admirably in handling heavy loads for the development of



**THIS IS WHAT** you see from the air. Note how the magnetic contour map below gives geologic significance to the topographic features discernible here.




**RIGHT-ANGLE BEND** in the river takes on structural significance when interpreted with this magnetic map. Note also alignment of lower right anomaly.

Operations Grasshopper transportation system. Eventually of course the seven fields will accommodate planes of the DC3 class.

Next phase in the development of air transport will be the construction of satellite Piper Cub fields 60 meters wide and 1,000 meters long for transportation of field exploration crews.

This in brief describes the modern air transportation system that is being installed to develop Surinam's mineral frontiers in the rain forest area.

Paralleling the development of the air transportation system is the airborne geophysical survey to be described later, and the work of the Surinam Geological & Mining Service (G&MS).

During three field seasons of 14½ weeks each, G&MS sends out 7-man reconnaissance crews working from base camps surrounded by eight small camps 7 to 15 km from the base camps.

A complete geological survey unit includes:

4 reconnaissance crews
1 preparatory crew
1 field geologist
1 field assistant
(A total of 38 men)

This force is expected to map about 3,000 sq km per year (1½ map sheets).

Within five years G&MS will need seven geological survey units, or approximately 266 men including 7 field geologists.

In addition, two geophysical units requiring a total force of 30 men including two geophysicists will operate from field camps to check airborne geomagnetic survey results.

Two complete mining prospecting field units, each under a mining engineer, and consisting of 3 prospecting crews of 14 men including the prospecting assistant, two core-drilling crews of five men and a drill foreman will make up a force of 106 men assigned to explore for mineral deposits.

Laboratory personnel of G&MS includes 5 petrographers and mineralogists and one chemist under a chief laboratory officer.

In addition to these aids and services for exploration engineers, the Government has provided ample library and map rooms for parties interested in studying Surinam's potential mineral resources.

## Operations Grasshopper Timetable in Brief Outline

In summary, the program for Operations Grasshopper was scheduled to function as follows:

**Second half of 1959:** Construction of five base airstrips in the southern area of Surinam.

**Fourth quarter of 1959:** Completion of part of the aerogeophysical survey. Start expansion of G&MS; procurement of most capital goods. Start air transportation system, especially to develop flying experience.

**First part of 1960:** Complete second part of the airborne geophysical survey. Draw up program for field work based upon results. Further expansion of G&MS. Complete switchover to air transportation.

**Middle of 1960-64:** Geophysical survey and mining prospecting of remaining unmapped part of interior. Emphasis will be shifted to prospecting as this stage nears completion.

**1962:** Construction of two more base airstrips—one in southeast Surinam, and one in northwest Surinam.

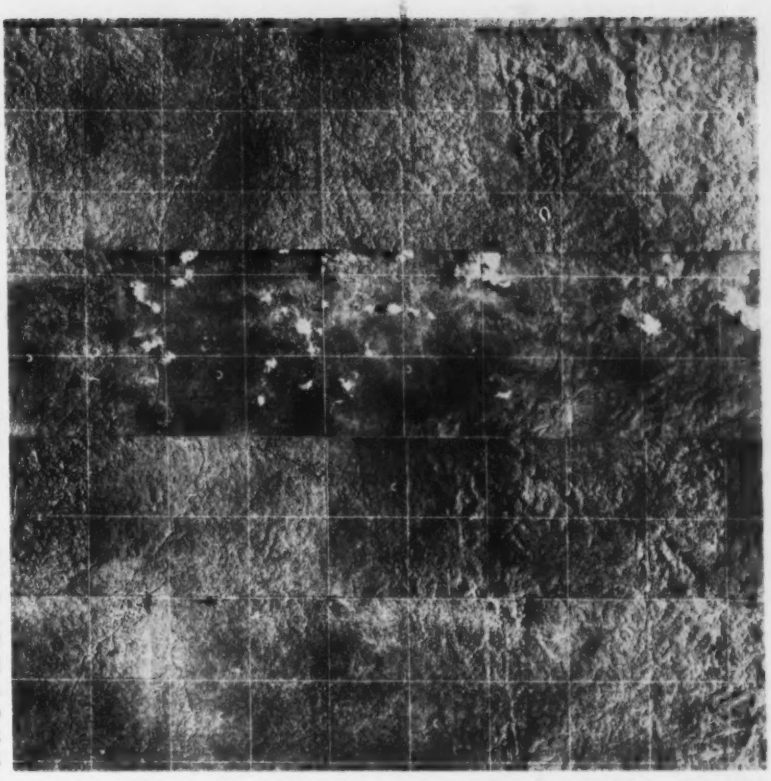
## The Aeromagnetic Survey

Surinam's planners paralleled the airborne jungle access program with an airborne geophysical program to inventory its mineral resources. By this method, it was assumed, a wealth of geological and geophysical data would be forthcoming that would attract mining companies seeking to develop properties to take a second look at the nation's mineral potentialities. Aero Service Corp., of Philadelphia, Pa., which had performed extensive geophysical and mapping surveys in nearby Venezuela and in many other parts of the world, was engaged to carry out the 66,000-mile, low-level magnetometer-scintillation counter survey over the unexplored region covered by Operations Grasshopper.

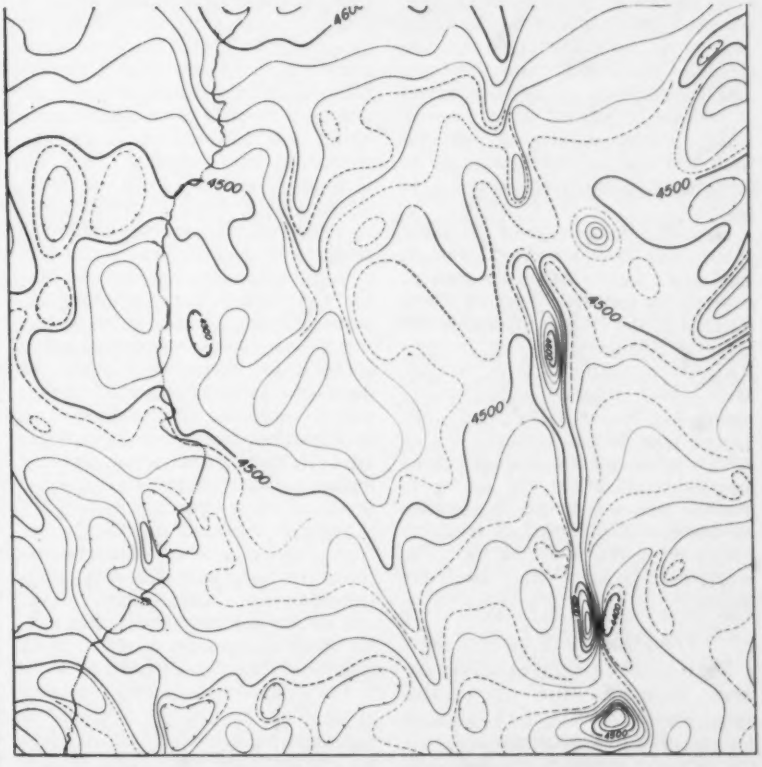
First stage of the survey in early 1959 was the study of photomosaics in the area south of the 5th parallel provided by Surinam's Central Bureau of Aerial Mapping. These photomosaics were provided by KLM which photographed southern Surinam in 1956 as part of an overall mapping program which started in 1947.

Aero Service assigned skilled photogeologists to study the mosaics for major geologic trends, and determine locations of massive granitic areas, intrusives such as dikes and metmorphosed series. This was difficult because most of the area is blanketed by rain forests. Here and there monadnocks, mountains, ridges, mesas and occasional outcrops provide sporadic clues to what lies beneath the jungle mantle.

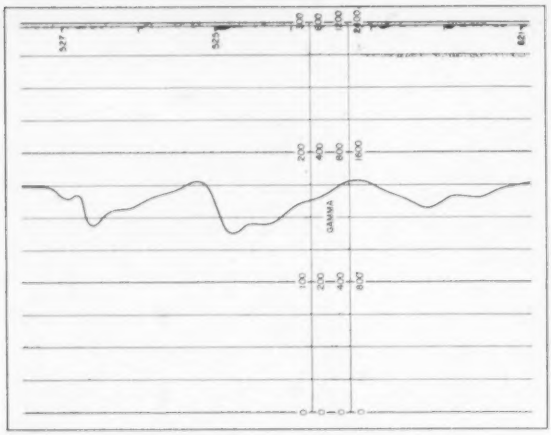
Drainage patterns, often completely masked by forests, were dimly disclosed by the undulations in the false plateau of tree tops. Here and there variations in photographic shading indicated hydrophyllic tree species that served as clues to drainage bottoms. (*Continued on p. 112*)



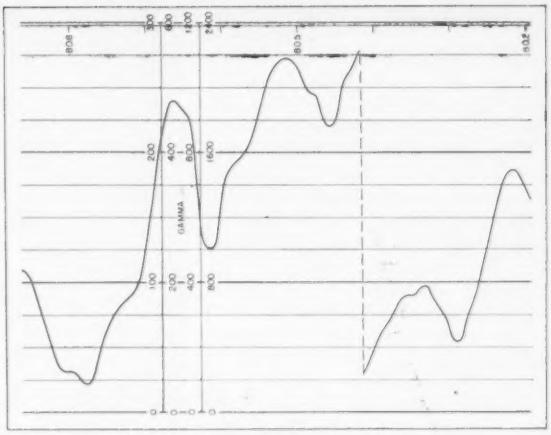
**AERIAL PHOTO** clearly shows a significant structural deformation, probably a dike in the lower right-hand quadrant of the photo.




**HERE AGAIN,** note how precisely the aeromagnetic-magnetic map confirms the structural delineation in the lower right quadrant.




**THIS MAGNETIC TRACK** tells the observer that he is flying over granitic rocks with uniform magnetite distribution.




**SHARP VARIATIONS** in magnetic track indicate basic igneous rocks with erratic magnetite distribution.

The accompanying preliminary geological map indicates rough geological provinces and trends that were read out of the aerial photomosaics. Also illustrated are two photomosaics showing drainage patterns that can be discerned from areas over massive granites and from areas over basic igneous and metamorphic rocks.

Chief purpose of the preliminary study, however, was to determine trend lines of major geologic structures. This is important in the planning of aerial geophysical surveys because flight lines must be pre-scheduled to go at right angles to these trends to reveal maximum significant data for mapping. Accordingly several systems of parallel flight lines on 1-km spacing at varying azimuths were laid out on pre-flight maps to conform to major geologic trends in Surinam.

Following completion of the aerial photo study in July 1959, equipment and crews were sent to Surinam to perform the geophysical survey. Units installed in the DC3 flying the survey included equipment for the Doppler RADAN navigation system, a Gulf Mark III airborne magnetometer mounted on the tail of the plane, a Mt. Sopris scintillation counter and a APN1 radio altimeter. A Gulf ground magnetometer station was set up to monitor magnetic storms. The 8-man crew consisted of two pilots, two electronics engineers, two data men, one geophysicist-geologist and one mechanic.

## Precision and Speed

Precision of an airborne survey depends as much upon three-dimensional position control at all times, as it does upon the accuracy and reliability of the magnetic and radiometric sensing and recording devices.

In the Surinam aero-geophysical survey, the RADAN navigation system employing the Doppler radar aid proved invaluable for several reasons. It maintains accurate position control and flight guidance without the need for establishing elaborate ground control stations. This accounted for much of the speed achieved in the Surinam survey. Secondly, the Doppler system is very reliable over featureless terrain. This has been demonstrated in Aero Service's survey with RADAN over 40,000 sq miles of territory in the central Sahara desert.

The accompanying illustration shows how the RADAN system guides a plane electronically from a starting point, along predetermined grid flight lines, around turns to final destination. "Black box" elements of the Doppler system indicate instantly even the slightest deviation from predetermined course. Ground distance can be measured and recorded within an accuracy of 1 or 2 parts in 1,000.

Continuous strip film exposed during flight enables data processing experts to check position points of actual flight against corresponding points on the master mosaic used to plan the flight grid. Intersections of flight lines with streams, topographic features or even towering jungle trees identifiable on both flight photo strips and the master mosaic provide a remarkable double-check for position control.

Fiducial reference marks are recorded periodically and simultaneously on the flight path film strip, magnetometer and scintillometer tapes, and on the altimeter record, thus keying three-dimensional position with geophysical data at all times.

To produce continuous magnetometer readings that are comparable and meaningful over terrain of varying elevation, the plane must fly at a uniform elevation of 500 ft above ground, even if the crew and plane have to hedgehop over acutely folded profiles of metamorphic structures. The altimeter guides the plane unerringly at proper elevations—the fortitude of the crew does the rest.

The vast amount of data amassed during flight is now being processed and reduced to map form at the Philadelphia offices of Aero Service. Some 264 map sheets, each comprising 500 sq km will be prepared ultimately to show variations in the earth's magnetic field plotted on 20-gamma contour intervals.

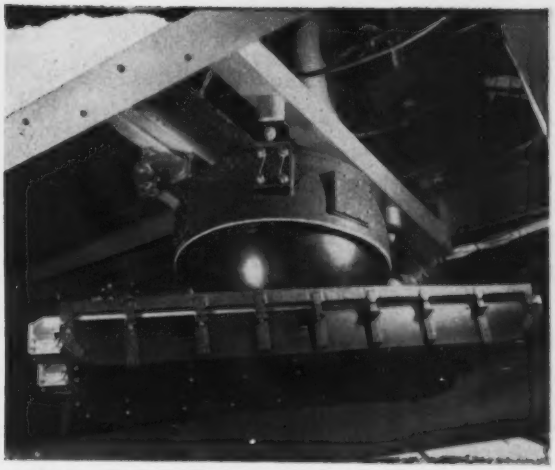
## Results of the Survey

Magnetic contours in some quadrants show a remarkable correlation to structural features reflected by physical features of the aerial photomosaics. In other quadrants, magnetic anomalies indicate geologic disturbances not betrayed by any physical features in the photomosaics. So in Surinam as elsewhere, interpretation of the geomagnetic maps can be expected to help exploration engineers work out structural details in some areas, and to search for buried mineral deposits in others.

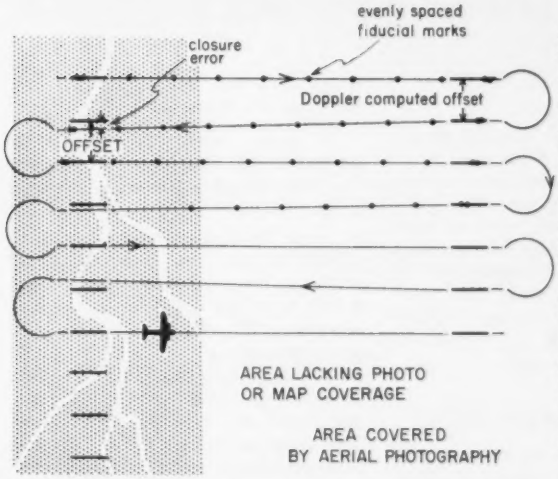
## The Expectations

Exploration engineers and geologists, without predicting specifically, agree that Surinam's position on the perimeter of the Brazilian Shield is geologically favorable for the discovery of mineral wealth. It will be recalled that many of the great mining areas of the world are similarly situated on shields in other continents. The presence of conglomerates and greywackes (closely related to conglomerates), several types of older granites), and gneisses, highly metamorphosed basic rocks and migmatites (mixed igneous rocks) confirms similarity of Surinam's shield areas to

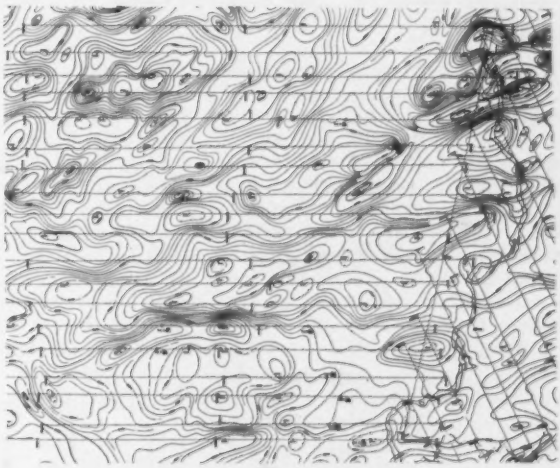
**DOPPLER-GUIDED PLANE** is equipped with magnetometer in the tail structure and scintillation counter within.



**PRECISION NAVIGATION,** so vital to airborne prospecting, was afforded by this Doppler unit installed in the plane.




**FLIGHT LINE GRID** shows how the geophysical plane was guided on uniform lines, 1 km apart, in Surinam survey.



**ACTUAL FLIGHT LINES,** predetermined to obtain maximum geological information are shown in this aeromagnetic map.

that of other shield formation.

Surinam's planners hold high hopes that the magnetic survey will reveal massive commercial iron-ore deposits beneath the dense jungle mantle. Even before the survey it was known that approximately 1-billion tons of laterite, averaging 30 to 35% Fe, existed near the Brokopondo dam area in northeastern Surinam. Another extensive deposit is known to exist near Majorodam Mt., southwest of Brokopondo.

Other potential ore-bearing areas are those where granites and other intrusives come in contact with rocks of sedimentary origin.

On a geological sketch-map of Surinam released in January 1959, the following mineral occurrences or indications were plotted: bauxite, beryl, cobaltiferous ore, copper mineralization, diamonds, gold, iron ore (ferruginous laterite), kaolin, Kyanite, amblygonite, manganese ore, cinnabar, mica, nickel-bearing rock, platinum, silica sand, columbium-tantalum ore, cassiterite and wolframite.

Exploration crews of Operations Grasshopper have already discovered diamonds near Table Mt in the central area.

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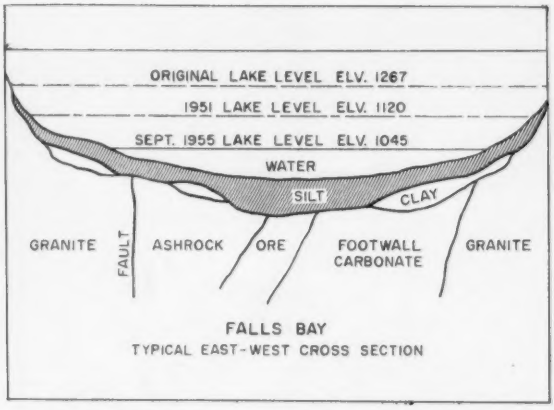
"Preliminary Abstract Concerning Pegmatite Investigations in Northeastern Surinam," H. T. L. van Eijk, Surinam, G&MS.

A list of publications of Surinam geology may be obtained from the Geological & Mining Service, Paramaribo, Surinam.

A map of Surinam showing airfields for commercial and exploration flights, also areas which have been mapped by aerogeophysical surveys appears on p 306.

**DREDGING** operations in other areas of Steep Rock helped Construction Aggregates Corp. reduce lake level at Falls Bay.




**OVER 150-MILLION** cu yd of silt have been removed from Falls Bay. The material is pumped four miles to Marmion Lake.

# Another Deposit Readied in Steep Rock

CALAND ORE CO., LTD., of Canada will begin mining 0.75-million tons of high grade iron ore in 1960 from below the silt bed of the Falls Bay area of Steep Rock Lake, Ont. Production will eventually reach 3-million tons per year. To make this possible, two 36-in. dredges have been working around the clock for five years to remove a total of 160-million cu yd of silt. The job has kept 250 men working in temperatures as low as 50° below zero.

The company, a subsidiary of Inland Steel Co., obtained a 99-year lease from Steep Rock Iron Mines, Ltd., for a 1,250 acre tract covering the "C" orebody in the Falls Bay area in 1953. Subsequent investigation revealed that a gigantic dredging job had to be undertaken as preliminary to creating an open-pit mine. Almost simultaneously, a three-phase plan was called for to facilitate final opening and working of the ore deposit. These phases were:

**Water control.** Dams, spillways, silt settling basins, control stations and other diversionary and control measures were established to keep the development area dry while allowing return drainage of water from the lake for pumping purposes.

**Construction.** A 5-mile railroad spur connecting the mine with the Canadian National Railway, a black-topped highway to link the Falls Bay area to the town of Atikokan and a 3,000-ft all-weather airstrip were built.

**Development.** A 5,000-ft conveyor, a crushing station and a loading plant were constructed. A 1,334-ft underground shaft was sunk to serve a future underground mine.

The job called for disposal of silt from Falls Bay by a pair of 36-in. dredges with discharge lines nearly four miles long, into Marmion Lake. Water from Falls Bay, used to flush out the silt, would then be permitted to drain back into its original bed to be re-used. In this way, the water body would be emptied and refilled 10 times before the overburden of glacial silt was removed.

## Dredges Remove Silt

By mid-1955, the 36-in. hydraulic pipeline dredges, "Clarence B. Randall" and the "Joseph L. Block" were assembled and the lake level lowered 75 ft. The dredges were designed and machinery constructed by the Ellicott Machine Corp., Baltimore. Construction Aggregates Corp. of Chicago, agents for Caland Ore Co., operate the equipment at the dredging site. The dredges are 50 ft wide, 176 ft long and 14 ft deep with a draft of 5 ft. Each weighs about 900 tons and is equipped with 10,000 hp electric engines. Within three years, the dredges had lowered the level of the lake from 1,120 ft to 920 ft, exposing the first outcroppings of ore. Pumping an average of 60,000 gallons of water per minute, they disposed of approximately 60,000 cu yd of silt a day.

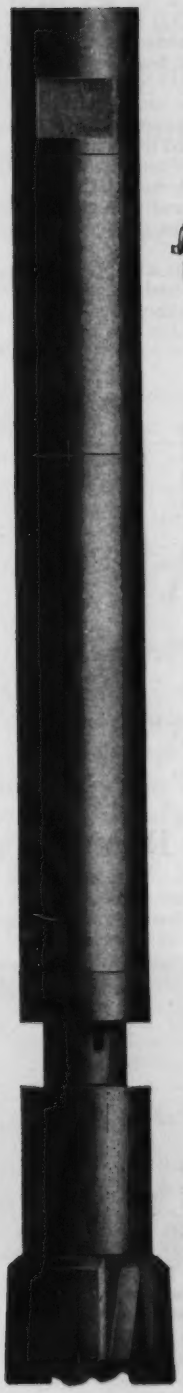
Fairweather Dam and Hardy Dam plus several smaller auxiliary dams had also been built to prevent surface run-off water from entering Falls Bay. Newly-built control stations at neighboring Marmion Lake and two other intervening lakes permitted the dredge water to drop its load of silt and flow back into Falls Bay to be used again.

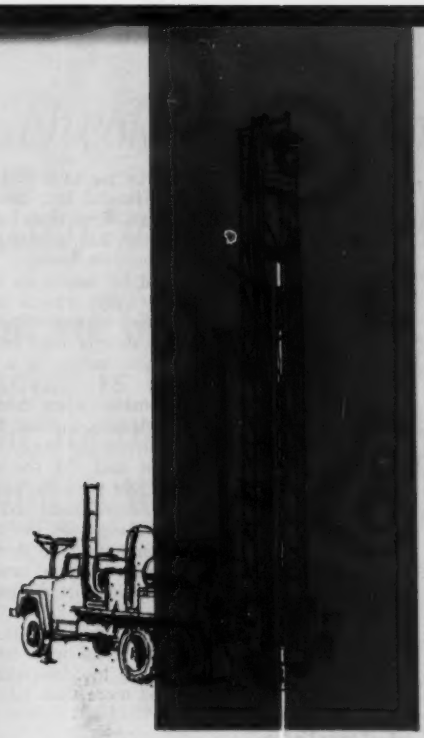
At present, only about 6,000,000 cu yd of silt remain to be dredged from the Falls Bay area of Steep Rock Lake.

Since dredging began, combined dredge outputs have averaged 4,000 cu yd per hour for light materials and 3,200 cu yd per hour for gravel and boulders. The dredges have removed approximately 150-million cu yd of overburden through pipelines that have averaged 5,000 ft of floating line and 10,000 to 15,000 ft of shore line. This does not include the vertical rise between booster stations, which, during the past year, has been between 500 and 600 ft.

By late spring of 1960, the first shipment of iron ore from this new source is slated to move from the open-pit mine, through the new crushing plants, across the giant conveyor and into waiting railroad cars at the loading station. From here it will move over the new spur line to Port Arthur and other Lake Superior ports where it will be loaded on ore vessels for shipment to Inland Steel furnaces.

Once in operation, Caland will join Hogarth, Barrier and Errington as producing mines in the range. Steep Rock Iron Mines, Ltd., shipped 2,746,849 tons in 1959 of which 2,389,796 tons came from the Hogarth and Barrier open pits and 357,053 tons from the Errington underground mine, which shipped 255,541 tons in 1958. Development work at the Hogarth underground mine was carried on the 900-ft and 1,100-ft levels; and dredging of the "G" orebody has been resumed.





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**MISSION HAMMERDRIL** A straight line, even in crooked hole country, means faster drilling. This bottom hole impact tool is not subject to hole deviation as other methods of drilling are. Straighter drilling and faster drilling mean more jobs and a bigger chance of success.

The fewer parts that move, the less chance for trouble. There are only two moving parts in the high pressure Hammerdril® and only three in the low pressure. Impact parts are heat-treated high alloy steel; moving parts are friction and wear resistant.

You can begin now to use the Mission Hammerdril on your present rotary rig simply by adding suitable air compressor capacity. You can begin now to cut the cost per foot of drilling through hard rock and still do that drilling better. And best, you can **re-sharpen** the massive tungsten carbide inserts in the Hammerbit® **in the field.** These inserts give maximum cutting efficiency and straight, full gauge hole.

The Mission Hammerdril is sold and serviced throughout the United States. Write for actual field savings under field conditions being realized by present Hammerdril users.

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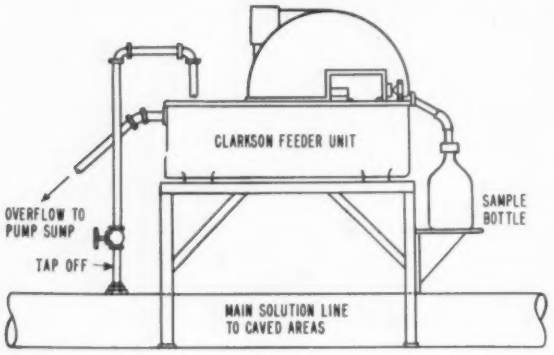
# OPERATING IDEAS

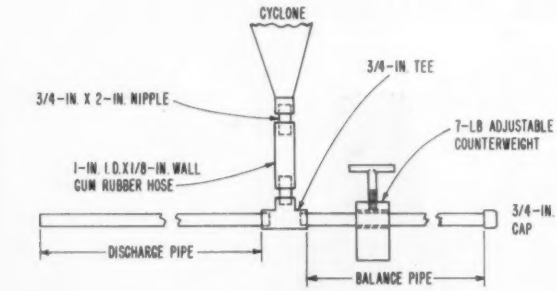


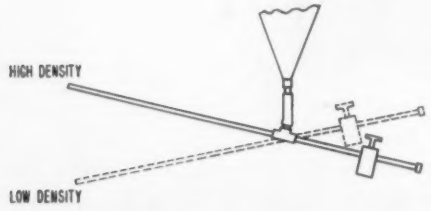

## At Miami, Feeder Now Samples

BY USING A STANDARD Clarkson reagent feeder, Miami Copper Co., Miami, Ariz., solved the problem of providing a dependable continuous solution sampler at the main pumping station supplying leach solution for caved mine areas.

A tap off on the main solution line provides a steady flow of solution to the feeder tank. Overflow from the feeder tank is returned to the pump sump through an overflow arrangement at one end of the tank. By simply adjusting the feeder cutter, any size sample can be taken. Cutter product is collected in a large sample bottle standing on a bracket attached to the steel-frame feeder base.

At Miami, a 24-hr sample has a volume measure of from 500 to 600 ccs.




## No Steady Check with Discharge

A SIMPLE, automatic sand density discharge for tailing dam cyclones has been developed at the mill of the Old Dick Div., Cyprus Mines Corp., Bagdad, Utah.

A. W. Hunt, mill superintendent, reported that the device has reduced constant attendance to a daily cyclone check.

Constant checks were formerly a must—mill feed's varying metal content produced corresponding changes in the cyclone rate and resulted in either choking or running of the cyclone sand discharge.

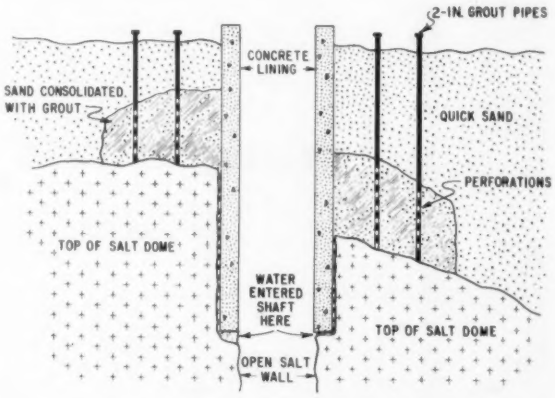
In the Old Dick installation, approximately 160 tons of tailing per 24 hr are handled by a 4¾-in. gravity-fed vertically-mounted cyclone from which sand is discharged horizontally through an elbow or tee to a ¾-in. pipe. The pipe, by swinging through a horizontal arc, can build up several ft of berm ahead of itself and at the sides before being moved. Overflow is discharged through 2-in. plastic pipe to the reverse slope of the dam behind built-up berm.

Sand density is controlled by raising or lowering the sand discharge pipe. Raising the pipe causes the sand to flow uphill and has the same effect as restricting the cyclone apex opening (resulting in a high density sand discharge); lowering the pipe, with opposite effects, results in a thin light density discharge.

Operation becomes automatic when horizontal sand discharge pipe pivots on a flexible rubber feed hose and is balanced by a sliding-counterweight arm.

"In operation," Mr. Hunt said, "if the tonnage falls and discharge thins out, the weight of pulp passing through the discharge pipe becomes less—more water and less sand present. This lighter weight is overbalanced by the counterweight and the discharge pipe tips up until the pulp thickens and equilibrium is reached. In the case of the sand discharge pulp thickening, weight increases in the discharge pipe and it tips down, clearing itself.

"The device in operation at Old Dick will allow the cyclone to discharge constant density sand with feed pulps varying from 1.250 to 1.700 sg, or 28 to 58% without resetting the adjustable counterweight, and more than takes care of normal variations in cyclone feeds."




## Low-Pressure Grout in Dome

WATER INTRUSION threatening one of the two shafts at International Salt Co.'s Avery Island, La., mine has been corrected by chemical grouting treatments applied at unusually low pressures and volumes.

The water intrusion problem developed in the mid-1950's at a 508-ft ventilation and access shaft dug in 1921. The 15x22-ft walls of the shaft are open salt except for the top 30 ft which are lined with a 12-in. concrete caisson that runs about 20 in. into the top of the salt dome.

Water had eroded the salt-concrete contact at the caisson's base and was entering the shaft, dissolving and eroding the walls all the way to the mine floor.

Several factors complicated the grouting operations at the base of the caisson: A water-tight seal had to be obtained between the salt dome and the overburden; the grouting fluid could have no effect whatsoever on the salt; and the fine water-bearing sand surrounding the shaft had to be consolidated.

Halliburton Oil Well Cementing Co.'s pressure grouting division was called in to solve the problem. During a series of tests under conditions simulating International's shaft, the division staff decided to use Halliburton's Blox-All grouting material mixed with water and an internal catalyst. They then began grouting operations at Avery Island.

# *Do you check these points When Buying* **STAINLESS STEEL** *Valves?*

- ☐ **How good are the castings?**
- ☐ **How precise is the machining?**
- ☐ **How rigid are the inspection and testing?**
- ☐ **How sound is the design?**

Just as important as a suitable stainless steel alloy are these four checks on valve quality. For long, dependable performance, a valve should rate *perfect* on every one.

There's a very good reason why you can be sure Jenkins Stainless Steel Valves will do that, unvaryingly:

For almost a century Jenkins has specialized in making valves. And making them to one standard of quality . . . the highest. Every operation and every worker is aimed at fulfilling that standard. The result is a product that can be backed by this 91-year-old assurance for valve users:

### *A Fair Offer*

*If you will put a Jenkins Valve, recommended for your particular service, on the worst place you can find . . . where you cannot keep other valves tight — and if it is not perfectly tight or it does not hold steam, oil, acids, water or other fluids longer than any other valve, you may return it and your money will be refunded.*

Order these reliable Jenkins Valves from your local Jenkins Distributor. Ask him or write us for Stainless Steel Catalog No. 59SS. Jenkins Bros., 100 Park Avenue, New York 17.

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The grouting material was repeatedly injected through two rings of 20- to 30-ft grout holes drilled from the surface.

The first stage of injections was made with Blox-All having a five-minute gel time, and injected at a maximum of 50 psi. For the second stage, Blox-All, with a 45-minute gel time, was injected at a maximum pressure of 30 psi. In each successive treatment, the gel times and injection pressures were varied in order to consolidate, but not displace, the formation.

A total of 30,965 gal of grouting material was pumped into the area surrounding the shaft in more than 1,000 separate injections.

Pressure tests and observation then determined that the shaft was dry and showed that the surrounding formation was consolidated.

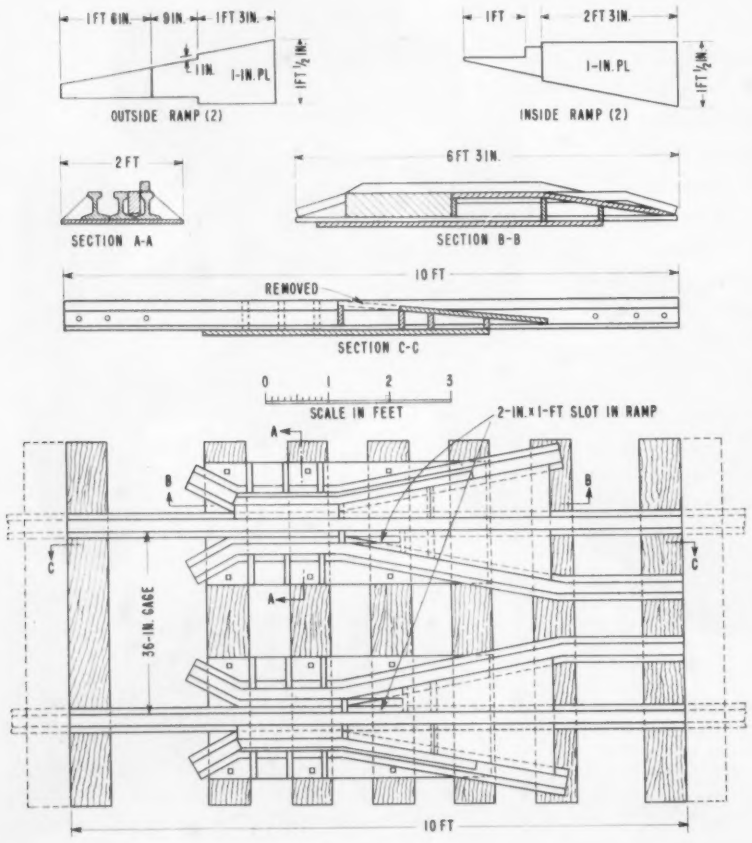
## Pima Keeps 'Eye' on Skip Load

THOUGH COMPLETE DESCRIPTIONS of rockover skip installations have already appeared in E&MJ (March 1958, p98; May 1960, p105), here's a construction detail that's worth mentioning. At Pima Mining Co., Pima, Ariz., photoelectric regulators stop overloaded skips so that they don't continue upwards and damage either the other loading gates or the headframe at the edge of the pit.

Pima's electrical department installed the regulators a short distance above each of the skip system's three loading gates. Each Worner Fotoelectric system consists of "two-unit" Model 2250 P&L set of electric eyes capable of operating a beam up to a range of 250 ft. An excessively high load, as it passes the beam, energizes the electric eye which in turn trips a relay. This slows the skip, and, after 10 seconds, cuts the power and sets the brake. All the electric eye setups are caged to prevent them being damaged by falling rock.

Another regulator, triggered by trucks returning from the primary crushing plant or stockpile, is able to cut down on headframe damage—trucks with high beds are signalled to stop before they even reach the headframe.

The Fotoelectric units cost about $108.



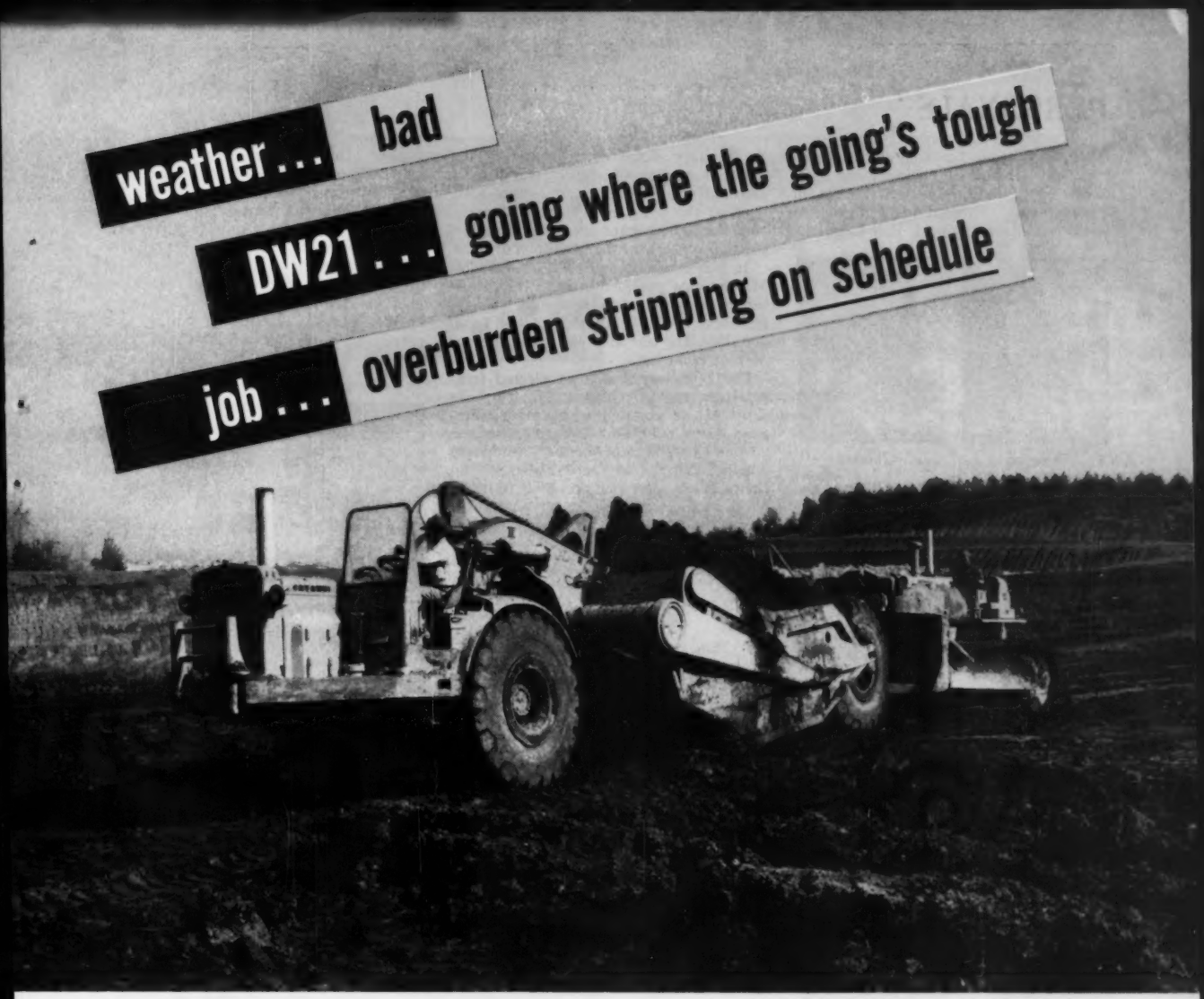

## San Manuel's Shop-Made Unit Re-Rails in Two Minutes

DERAILED MINE CARS can be put back on track in two minutes by a re-railer unit built at the shops of San Manuel Copper Corp., Tiger, Ariz.

The re-railer, designed for a 36-in. gage track system made up of 90-lb rails, was installed 50 ft ahead of the first chute in the track section leading to the loading chutes below the undercut and producing ore block.

When derailed, San Manuel's 13-ton car is drawn or pushed onto the built-in ramps until all of its wheels roll on the regular track.

In the past, the job of putting a derailed car back on the track required a minimum of 30 minutes.




Job—1,200,000 yards of clay, sand and lignite to be moved in 6 months. Working 12 miles southwest of Little Rock, Arkansas, Dulin & Co., Inc. stripped overburden 55′ deep for a bauxite mine. Heavy rains made haul roads slippery . . . load and dump areas mucky.

But the job was completed on schedule. Five DW21s and 470B Scrapers moved 10,000 cu. yd. per 20-hour day. They carried 16 bank cu. yd. on a 3600′ cycle.

Here's what Superintendent Clyde Moore has to say about the DW21s: "We're a 100% Cat-equipped company. The new DW21 is the best hauler we've ever used. It's got lots of speed and traction. It goes through mud that's tough for track-type tractors."

This is the kind of performance you can expect from the new DW21G. Its 345 HP diesel delivers 12% more rimpull which provides up to 20% faster speeds than the former models over similar haul conditions. To handle this increased horsepower, the DW21 has stronger final drive gears and improved transmission shifter forks. The matching 470B LOWBOWL Scraper has greater capacity . . . 19.5 cu. yd. struck . . . 27 cu. yd. heaped. Stronger bowl, draft frame and apron result in longer service life, less maintenance.

The new DW21 is geared for today's highly competitive market. It's a high-capacity rig designed to move more dirt at a lower cost.

Pick your toughest job. Then pick up your phone and call your Caterpillar Dealer. Ask him to demonstrate the heavy-duty, profit-making DW21.

Caterpillar Tractor Co., General Offices, Peoria, Ill., U.S.A.

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# PERSONALS

**Henry S. Wingate** has been elected chairman of the board of directors and chief officer of the International Nickel Co. of Canada Ltd. Succeeding Wingate as INCO president will be **J. Roy Gordon.**

Wingate

Gordon

Parker

Elected to the post of senior vice president was **Ralph D. Parker.** He has served as vice president in charge of Canadian operations since 1955.

**Dr. John F. Thompson,** former chairman of the board, has become honorary chairman and will continue as chairman of the executive committee.

Wingate joined Inco in 1935 as assistant secretary; he was made secretary in 1937, director in 1942 and president in 1954.

The new president became affiliated with the company in 1936 as director of research. In 1941 he became assistant to the vice president, assistant general manager of Canadian operations in 1952, vice president in 1953 and executive vice president in 1957.

Cabell

Waddington

Parlee

Gagnebin

**Richard A. Cabell, Albert P. Gagnebin, Ralph H. Waddington** and **James C. Parlee** were elected vice presidents of the company.

Cabell has been assistant vice president of Inco and vice president of its U.S. subsidiary, International Nickel Co. Inc.; Gagnebin, vice president and manager of the primary nickel department of International Nickel Co. Inc.; Waddington, assistant vice president and general manager of the company's Ontario division; and Parlee, assistant vice president and general manager of the Manitoba division.

It was also announced that **John A. Marsh,** vice president of the U.S. subsidiary, was elected to the further office of president of its Huntington Alloy Products Div. He was also elected a director of that company.

**Paul Queneau** has been elected technical assistant to Gordon. He has been assistant vice president of the parent company. He, Cabell and Gagnebin continue also as vice presidents of the subsidiary.

Other officers of Inco re-elected are: **Lance H. Cooper,** vice president; **William F. Kennedy,** secretary; **F. M. A. Noblet,** treasurer; **Walter A. McCadden,** comptroller; and **H. G. Fales,** assistant to the chairman.

**W. John Gould** was newly elected deputy comptroller and **Dean D. Ramstad,** assistant secretary of the company.

**Mark Lintz,** consulting mining & metallurgical engineer of Prescott, Ariz., is currently in Northeastern Mexico on phosphate exploration work.

**Kenneth M. Haley** has been promoted to assistant manager of Reserve Mining Co.'s Silver Bay Div. **Donald E. Cooksey** was advanced to superintendent of the pelletizing department.

Both Haley and Cooksey have been engaged in the development of pelletizing iron ore concentrates since 1949. In 1956 they were awarded the University of Minnesota Institute of Technology's plaque and replica of the famed "Lynn kettle" for their contributions to taconite processing.

In 1934 Haley became a member of Armco Steel Corp.'s metallurgical department and advanced to junior metallurgist and senior metallurgist by 1941. In 1948 he became superintendent of the Ashland pilot plant. He joined Reserve in 1952 as superintendent of pelletizing and moved to Silver Bay in 1955.

Cooksey became general foreman for Armco in 1949. He joined the Reserve organization in 1952. In 1955 he was promoted to assistant superintendent of the pelletizing department at Silver Bay, which position he held until his advancement to superintendent.

The boards of directors of the M. A. Hanna Co. and Hanna Mining Co. each authorized a realignment of executive responsibilities last month by advancing top officers of both companies in the following manner:

**Joseph H. Thompson,** president of M. A. Hanna since 1952, was made vice chairman of the board. **George H. Love** of Pittsburgh continues in the office of chairman. Mr. Thompson is also chairman of the Hanna Mining Co. and is president and chief executive officer of Iron Ore Co. of Canada.

**Gilbert W. Humphrey** was elected president and chief executive officer of M. A. Hanna. He was formerly president of Hanna Mining, where he will continue as a director, and an M. A. Hanna vice president.

**W. A. Marting** became president and chief executive officer of Hanna Mining. He was formerly executive vice president and is a director of both companies.

**R. W. Whitney,** formerly Hanna Mining vice president in charge of mining operations, was named executive vice president.

**Colin C. McAneny** has joined the staff of E&MJ as an assistant editor. McAneny came to E&MJ from Hayden, Ariz., where he worked for Kennecott Copper Corp. as a reduction plant test engineer and engineer trainee. A 1952 graduate of Princeton University, he served in the U.S. Navy from 1952 to 1956. He studied mineral engineering at Massachusetts Institute of Technology from 1956 to 1958, before joining Kennecott.

McAneny

**H. R. Rice,** professor and head, department of mining engineering, University of Toronto, is to visit Russia in May and June, on an exchange lectureship arranged between the Academy of Sciences of the USSR and the National Research Council of Canada.

**Howard L. Waldron,** formerly professor of mining engineering at the University of North Dakota, has accepted a position as engineer for Barodynamics Inc., Georgetown, Colo. He is presently working for the firm's rock mechanics division.

**Frank Coolbaugh** has been elected president of American Metal Climax to succeed Walter Hochschild, who was elected chairman and chief executive officer.

Coolbaugh

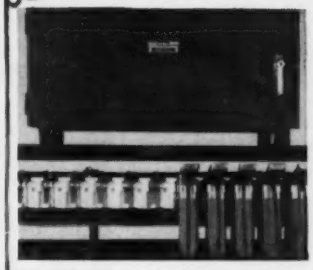
Hochschild succeeds **Arthur H. Bunker** who is retiring. Bunker will remain with the company as honorary chairman and chairman of executive committee.

The resignation of **Weston G. Thomas,** executive vice president, has also been announced. He served as executive vice president of Climax Molybdenum Corp. until its merger with American Metal in 1957.

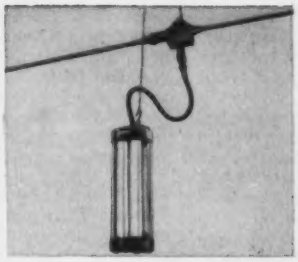
Hochschild joined American Metal Climax in 1920 and became president in 1950. After the merger he was named vice chairman and president.

Coolbaugh joined Climax Molybdenum in 1933 and became vice president of Western operations in 1954 and in 1959 became president of the Climax Div. of the merged company. He was elected a director of Climax in 1955 and of the combined company upon the merger.

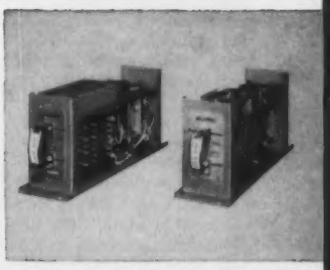
☐ **NEW EDISON MODEL 5 ELECTRIC CAP LAMP** provides greater safety for the miner, higher production for the operator. 15% increase in illumination. Smaller, lighter-weight headpiece. Improved battery.



☐ **M-S-A® AUTOMATIC LOW-VOLTAGE CHARGING SYSTEM** is designed for the most economical method of lamp charging. Miners can put their lamps on charge with one motion and keep moving without any delay.



☐ **M-S-A® PERMISSIBLE MINE LIGHTING SYSTEM** cuts down accidents. Increases production. Provides dependable lighting with an instant start circuit. Available for either 110 or 220 volt AC circuits.



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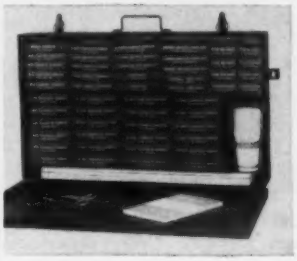
☐ **M-S-A® MINEPHONE** coordinates trip traffic for safe, fast, productive haulage control. Motormen have clear, instant voice communication with the dispatcher or other motormen while trips are moving. Installs easily.



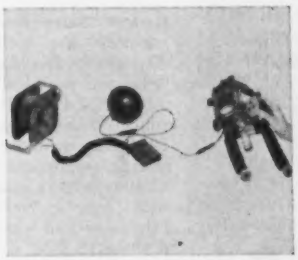
☐ **M-S-A® MINER'S FIRST AID CABINET** provides medical dressings and equipment for mine hospital or dressing station. Each unit package individually wrapped in cellophane. When open, lid serves as a work shelf.

☐ **M-S-A® ALL-SERVICE® MASK** with new Window-Cator canister, external check valve and M-S-A Clear-tone Speaking Diaphragm gives dependable breathing protection against smoke, toxic gases and fumes.

☐ **M-S-A® CHEMOX® BREATHING APPARATUS** completely safeguards breathing while travelling through any gaseous or oxygen deficient area. Generates its own oxygen supply from replaceable canister.

☐ **M-S-A® SELF-RESCUER®** gives immediate breathing protection in emergencies caused by fire or explosion. Compact. Lightweight. Can be stored without deterioration. Available in storage cases or individual carrying cases.

☐ **M-S-A® DUSTFOE RESPIRATOR** is light and compact for dependable protection against dusts, vapors, and mists. Allows maximum vision by the wearer. It's easy to clean. Design is modern and functional.



☐ **M-S-A® MINE RESCUE COMMUNICATION SYSTEM** with speaking diaphragm face piece sets up positive "party line" communication between rescue team and fresh air base. Transistorized. Battery-powered.

☐ **M-S-A® TYPE K SKULLGARD® HAT WITH NEW FIXED-CROWN* SUSPENSION** is safest on the outside, safest on the inside. New suspension provides an extra margin of safety which is completely tamper-proof.

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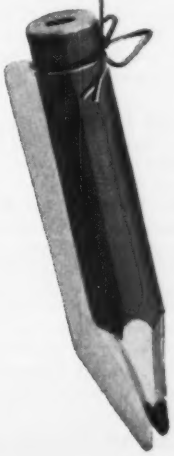

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Check off the MSA products which you would like to know more about. Then tear out this page, send it to MSA. We will send you the additional information requested. An MSA representative will be pleased to relate the advantages of these items to your operation: in terms of full-shift protection, more tons per man. No obligation, ever.


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# PERSONALS *(Continued)*

**Dr. Paul F. Kerr,** Newberry professor of mineraology at Columbia University, has been awarded an honorary Doctor of Science degree by Occidental College in Los Angeles.

**Charles I. Eisenhart** has been promoted to triple superphosphate manager at American Cyanamid Co.'s Brewster Plant. He succeeds **F. A. O'Neall** who has been named assistant chief engineer.

Eisenhart moves into his new job from the position of assistant triple superphosphate manager which he has held since last October. He joined American Cyanamid in 1958 and served as chemical engineer and senior chemical engineer before moving into the triple department.

He is a member of the American Institute of Chemical Engineers.

**Eisenhart**

**O'Neall**

**W. L. Kendrick,** vice president and general manager of Howe Sound Co.'s Manganese Inc., is now vice president and general manager of the Tungsten Corp. mine at Henderson, N.C.

**E. B. Douglas,** general manager of the Calera Mining Co. has replaced Kendrick as general manager of Manganese Inc. **Russell Frith,** electrical superintendent at Manganese, has also been transferred to North Carolina.

**S. J. McCarroll,** Howe Sound consulting engineer who has been in temporary charge of the North Carolina operation, will return to his headquarters at the Manganese plant.

**C. Harry Burgess** was recently elected vice president, exploration, of Kennecott Copper Corp.

**Burgess**

Burgess has been president of Bear Creek Mining Co., Kennecott's domestic exploration subsidiary, for the past four years. He joined Kennecott in 1952 as a geologist.

During 1944-46 he was with the consulting firm of Hoover, Curtice & Ruby, engaged chiefly in exploration work in Africa and Latin America. Subsequently, he was a geologist for the M. S. Hanna Co. and, in 1959, he was appointed director of the Strategic Materials Div. of Economic Cooperation Administration in Washington, D. C.

Kennecott has also announced the appointment of **Robert H. Lounsbury** as general counsel.

**Augustin L. Queneau,** metallurgical consultant to a number of metal companies and retired technical assistant to the president of U. S. Steel Corp., has been awarded the "Egleston Medal," Columbia University Engineering School Alumni Assn.'s highest award for "distinguished engineering achievement."

**Dr. Maurice Ewing** received the first Vetlesen Prize for outstanding achievement in the earth sciences at a recent dinner at Columbia University.

In receiving the geophysicists' gold medal and $25,000, Ewing was told that he was "not only one of the world's outstanding geophysicists, but also one of the world's outstanding men in the earth sciences."

**Peter P. Ribotto,** manager of Inland Steel Co.'s Caland Ore Co. Ltd., has been elected vice president.

Ribotto, who has been with Inland since 1940, has been manager of the Canadian subsidiary since January 1959. Before that he was chief engineer of the company's ore mining operations in Michigan and Minnesota.

**Lloyd S. Campbell,** assistant to the vice president of operations for U.S. Steel Corp.'s Iron Mining Div., has been appointed vice president of the Michigan Limestone Div.

**James S. Vanick** has retired as research metallurgist with the Development & Research Div. of the International Nickel Co. Inc.

**Vanick**

Mr. Vanick joined International in 1922. Prior to that he served as research associate at the U.S. Bureau of Standards for the U.S. Army, and as Engineer of Tests with the British Ministry of Munitions.

**Dr. George E. Holbrook,** a vice president, director and executive committee member of E. I. du Pont de Nemours & Co., has been elected vice president of Engineers Joint Council. Dr. Holbrook succeeds **Cecil Boling,** who has resigned.

**Dr. James M. Neilson,** professor of geology at the Michigan College of Mining & Technology, has been appointed assistant dean of the faculty of the college.

**Frank J. Everard** has been appointed departmental assistant director of the Ontario Research Foundation in charge of Ore Dressing Section and Pilot Plant at Rexdale, Ontario.

## OBITUARIES

**George Bates Harrington,** 79, mining engineer and mining company official died in Chicago May 13.

He was president of the Chicago, Wilmington & Franklin Coal Co. of Chicago which he headed since its organization in 1914. He spent several years in metals mining operations in Mexico and the southwestern United States and served with Stone & Webster Co. in Seattle, a firm associated with Chicago, Wilmington & Franklin Coal Co.

**Howard G. Satterthwaite,** 69, retired manager of the Anaconda Aluminum Reduction Works, died May 11 in Escondido, Calif.

Satterthwaite, who was with the Anaconda Co. from 1916 to his retirement in 1958, rose from laborer to assistant general superintendent of the Great Falls Reduction plant before becoming manager of the Columbia Falls aluminum plant in 1952.

**James M. Knox,** 56, vice chairman of the board of directors and former president of Research-Cottrell Inc., died May 9 after a long illness.

Mr. Knox joined Research Corp., of which Research-Cottrell is a wholly-owned subsidiary, as financial vice president in 1951. With the formation of Research-Cottrell in 1954 he was elected secretary-treasurer and a director of the subsidiary company.

He served as executive vice president in the year prior to his election as president. He served as president from November 1958 until January of this year when he resigned because of illness.

**Robert H. Sayre,** 74, mining engineer, died May 8 at a Denver hospital.

Mr. Sayre, who had been in semi-retirement the past eight years because of ill health, was active in many mining developments in the Rocky Mountain area.

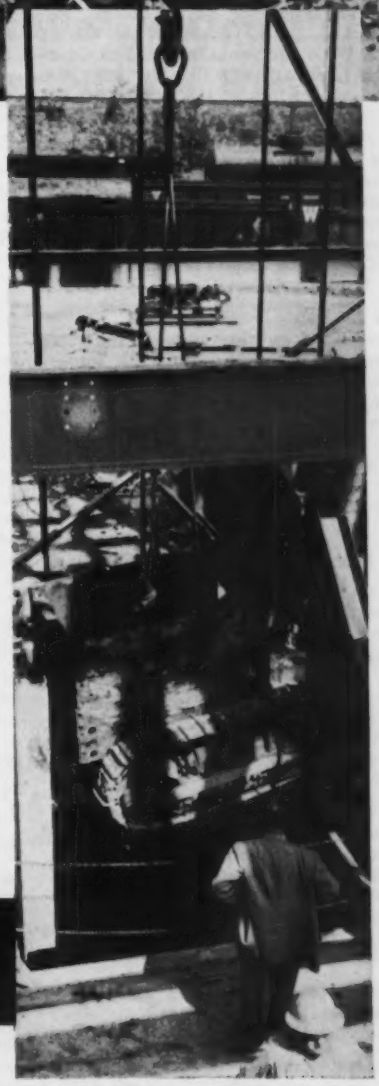
**Jerome L. Drumheller,** 90, who developed a number of mining and oil properties in the Pacific Northwest, died in Spokane May 2.

**Raymond E. Franklin,** mining engineer and placer mining expert, died in San Fracisco at the age of 75. Franklin, for a time, managed one of the world's biggest gold mines, in Colombia, where he was associated with Pato Consolidated Gold Dredging Ltd.

**Gerald J. Ballmer,** 62, retired general superintendent of mines at Kennecott Copper Corp.'s Chino Mines Div., died March 9.

Mr. Ballmer began his employment at Chino as an engineers' helper in 1925. He was subsequently promoted to the positions of assistant mine engineer and geologist.

In 1936, Mr. Ballmer was appointed general mine foreman. He then became assistant mine superintendent and was named general superintendent in 1947. He retired July 1, 1959.



## *"18' IN ROCK SHAFTS SUNK AND CONCRETED 800 FEET IN 85 WORKING DAYS WITH EIMCO 630 IN CLEVELAND, OHIO"*

**Report on Joint Venture by Frazier-Davis Construction Co. and Hunkin-Conkey Construction Company.**

"An Eimco 630 Excavator is loading an average excavation progress of 15 feet per working day in 18 foot diameter shafts in rock. Average mucking time is 6.25 minutes per three cubic yard bucket or 28.8 cubic yards per hour. One operator has averaged as high as 30.9 cubic yards per hour for a two week period. Part of this mucking operation is accomplished inside the concrete forms with a working diameter of only 15' 4". Average shaft progress is 9.41 feet per day, including concrete lining and utilities."

So reports A. Leavitt Crowell, Project Manager for Frazier-Davis Construction Company on two vertical shafts for International Salt Company at Whiskey Island, Cleveland, Ohio.

Shafts will go about 1,900 feet and with two Eimco 630's on the job, you may be sure the job will be completed fast and economically. Proven in service around the World, the Eimco 630 is reliable, tough and efficient.

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# WHAT'S NEW IN PATENTS

**OLIVER S. NORTH**

## U.S. PATENTS

### Exploration

**In an apparatus for aerial electromagnetic exploration** of conductor orebodies, either the in-phase or out-of-phase components of the received voltages may be compared. M. Puranen, assigned to Canadian Airborne Geophysics Ltd. No. 2,931,973.

**Geophysical method for locating and distinguishing** between conductor and magnetic orebodies. Time transients of the earth's magnetic field are determined at several points and these data are correlated for detection of any anomaly in the area. Presence of mineral bodies produces a measurable alteration in the amplitude, direction and phase of the random magnetic fields. G. H. McLaughlin, H. A. Harvey, W. O. Cartier and W. A. Robinson, assigned to Crossland Licensing Corp. Ltd. No. 2,931,974.

### Mining

**An explosive for use in wet blast holes,** consisting of an aqueous slurry of ammonium nitrate or sodium nitrate, aluminum powder, and plus 30-mesh trinitrotoluene, has been patented by M. A. Cook and H. E. Farnam, Jr., assigned to Iron Ore Co. of Canada. No. 2,930,-685.

**Design for an apparatus for collecting churn or core drill cuttings** for inspection and analysis. Cuttings are deposited continuously in a transparent container, where they may be examined constantly by eye. Changes in strata type can be immediately noted, rather than waiting for the material to settle in a tank. C. E. Batterson. No. 2,931,509.

### Metal & Mineral Processing

**In the removal of silica from iron oxide ores,** the ore is fed onto an inclined conveyor belt having transverse riffles reaching only part way across. Water is fed to the moving belt to sluice silica tailing to the unriffled side. Ore can be substantially upgraded in a single pass down the belt. N. H. A. Rodman, assigned to Oreclone Concentrating Corp. No. 2,930,-484.

**To permit less hazardous and more uniform** operation of a zinc smelting furnace, a combination bumping and sampling device is provided for removing retort crusts and recovering zinc-rich residues from the open end of the retort. C. G. Harbordt and B. F. Buff. No. 2,931,059.

**In the reduction smelting, refining,** or other heat treatment of ores or other metal-containing charges, the material is heated in a horizontal rotary furnace rotating at sufficient speed to exert centrifugal force on the charge and maintain it in fixed contact with the inner surface of the furnace. This process is claimed to be suitable for production of a wide variety of metals from their oxides, carbides or sulphides, and for the refinement of zinc and other metals. O. C. Aamot. No. 2,931,708.

**In the production** of strong and relatively large agglomerates of iron oxide ores, the fine ore is mixed with small percentages of sodium hydroxide, magnesium hydroxide and calcium hydroxide in the presence of water, the mixture pelletized or briquetted, and the units heated to not over 1100° C for from 15 min. to 4 hrs. J. M. Lee assigned to Dow-Chemical Co. No. 2,931,717.

**Method and apparatus** for automatically measuring and controlling the moisture content in an iron ore sinter mix being fed to a sintering machine. Stack gas moisture is determined, correlated with other operating variables in a computer mechanism, and the supply of water regulated by controls from the computer. M. J. Greaves, assigned to Arthur G. McKee Co. No. 2,931,718.

**Method for continuous extraction of uranium** from an ore leach solution, or from liquid of a de-sanded leach pulp, by means of a moving bed of 10-30 mesh ion exchange resin particles, eluting uranium from loaded resin, and recycling regenerated resin. The liquid flow is pulsated through the bed. D. E. Weiss and E. A. Swinton, assigned to Commonwealth Scientific & Industrial Research Organization. No. 2,932,552.

**In the fluidized bed roasting of sulphide ores** of nickel, copper, zinc, gold, iron, etc., a slurry of slimes-containing concentrate is sprayed into and through the hot freeboard space to produce very small wet agglomerates, and these particles are dried in the freeboard space prior to their settling to the bed. Particles do not adhere to each other in the bed. P. G. Thornhill and J. M. McKay, assigned to Falconbridge Nickel Mines Ltd. Nos. 2,930,604 and 2,930,687.

**In the blast furnace smelting of oxidized zinc ores** or roasted zinc or zinc-lead sulphide ores, the efficiency of the zinc or zinc-lead recovery is improved by controlling the composition of the slag by adjustment of the relative contents of iron oxide, silica and lime in the charge. J. Lumsden, assigned to Metallurgical Development Co. No. 2,932,566.

**In the preparation of a titanium dioxide concentrate** from ilmenite or other titaniferous iron ore, the ore is mixed with petroleum coke and the mixture heated to convert the iron to ferrous form and then selectively chlorinated to eliminate ferrous chloride and leave a carbon-containing titanium dioxide residue which is ideally suited for further chlorination to produce titanium tetrachloride. F. E. Love, L. R. Lyons and J. C. Priscu, assigned to Titanium Metals Corp. of America. No. 2,933,373.

**In the recovery of lithium hydroxide** from Searles Lake dilithium sodium phosphate, or from phosphoric acid-treated caustic liquors produced in the processing of spodumene, petalite or other lithium ores and like materials, the source material is calcined with lime and alumina and then digested in lime water. L. J. Reader, assigned to Foote Mineral Co. No. 2,931,703.

**In the recovery of thorium and rare earth values** from metallurgical sludges, the sludge is leached and the soluble salts removed. The leach solids are calcined, treated with magnesium fluoride and thorium or rare earth oxides, the mixture digested in an acid, and the precipitate washed and dried to obtain the thorium or rare earths in fluoride form. J. P. Flynn, assigned to Dow Chemical Co. No. 2,932,555.

**COPIES of U.S. patents can be purchased at 25 cents each from Commissioner of Patents, Washington 25, D. C.**

**In the low temperature reduction of magnetic iron ores** or oxidized hematite, limonite, taconite, etc., the ore is brought into whirling contact with pulverized coal containing a bitumen or gas at a temperature of 350-450° C. K. von Haken, one-third assigned to Johannes Bernhard Hahn. No. 2,932,563.

**In the beneficiation of low-grade nonmagnetic iron oxide ores,** in which the mineral particles are too fine for concentration by gravity methods, the ore is subjected to a magnetic roast in a shaft furnace countercurrent to a flow of heated gases containing a large proportion of nitrogen and carbon monoxide and a small proportion of carbon dioxide and/or hydrogen. F. D. De Vaney, assigned to Pickands Mather & Co. No. 2,931,720.

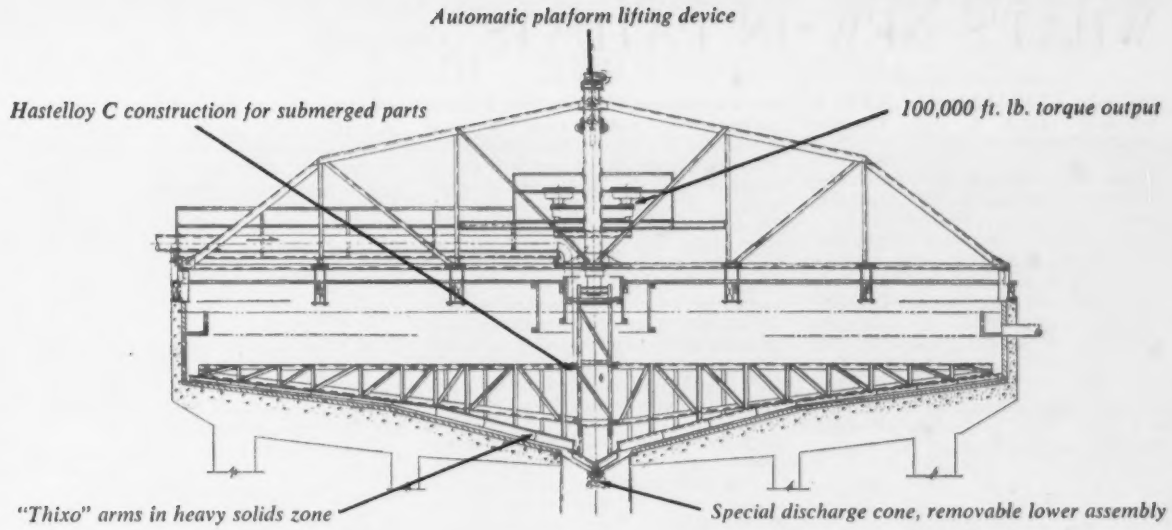
**Design for a disk type filter** for use in the concentration and dewatering of mineral slurries, wherewith the pulp is agitated in the bottom of the tank so as to prevent stratification and settling of solids. Use is not made of rotating parts in the tank, thereby eliminating need for packing glands. L. H. Logue and A. C. Daman, assigned to Denver Equipment Co. No. 2,932,402.

## CANADIAN PATENTS

### Exploration

**In electromagnetic exploration for conductor orebodies,** an improved receiver coil is provided for insertion into a drill hole. This coil unit can withstand pressures encountered in even the deepest

Mr. North is patent consultant, Washington, D.C.


Automatic platform lifting device
Hastelloy C construction for submerged parts
100,000 ft. lb. torque output
"Thixo" arms in heavy solids zone
Special discharge cone, removable lower assembly

# Unique Thickener Features Solve Difficult Recovery Problem at Freeport Nickel Co.

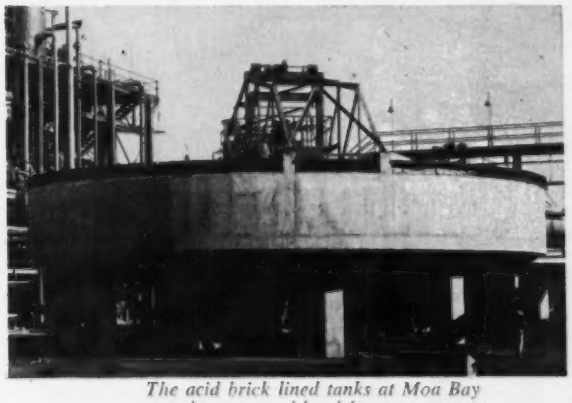
For difficult thickening conditions, it would be hard to beat those in the sulphide circuit at Freeport Nickel Company's Moa Bay extraction plant in Cuba. Consider these built-in problems:

. . . a feed of precipitated cobalt and nickel sulphides in a dilute sulphuric acid solution containing hydrogen sulphide gas.

. . . a process temperature of 190°F.

. . . 5.16 specific gravity solids that settle rapidly to 70%, at which density they are very difficult to pump.

. . . a need to clarify and recover the overflow.



*The acid brick lined tanks at Moa Bay are above ground level for easy access to discharge cones. Wooden covers confine hydrogen sulfide gases.*

These unusual conditions obviously required an unusual solution, and close work between the Freeport engineers, C. F. Braun & Co. engineers and Eimco-Process resulted in two thickeners with unique features specifically designed to recover the valuable sulphides.

To resist corrosion, and because of the elevated temperature, all submerged parts were constructed of Hastelloy C. To permit raking the heavy solids at close to the 70% concentration limit while clarifying the overflow, 100,000 ft. lb. torque output driveheads were used instead of the standard 36,000 ft. lb. torque usually provided for 60 ft. tanks. Platform lifting devices, controlled by torque transmitters, were designed to automatically raise and lower the entire raking mechanisms in the pulp to compensate for varying loads.

In the inner 30 ft. dia. of the tank bottoms, Eimco-Process "Thixo" arms were used so that the lower chords of the raking trusses would be above the heaviest pulp. Finally, to ensure efficient underflow withdrawal, special discharge cones with removable lower assemblies were devised. These connect to rubber hose underflow lines and are fitted with high-pressure water connections for quick unplugging.

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# WHAT'S NEW IN PATENTS *(Continued)*

drill holes. G. H. McLaughlin and W. A. Robinson. March 8, 1960. Canadian 593,776.

**Improved arrangement of airborne electromagnetic equipment** for establishing the existence of a subsurface conductor orebody. Employment of a unique feedback technique eliminates the need for using gain stabilized amplifiers. A primary alternating flux field is established, and the resulting voltage is measured in a pick-up coil as the primary flux field passes through its zero and peak values. Diagnostic data obtained have excellent accuracy and reliability. K. A. Ruddock and A. A. Brant, assigned to Newmont Mining Corp. March 8, 1960. Canadian 594,056.

## Mining

**In a method for neutralizing** the silicosis-producing properties of finely pulverized siliceous material, extremely fine particles of aluminum oxide powder are disseminated in the atmosphere. The solubility of the silica particles in the lungs is reduced, thereby lessening their toxic or fibrosis-producing effect. J. W. G. Hannon, assigned to McIntyre Research Foundation. March 22, 1960. Canadian 594,861.

## Metal & Mineral Processing

**In the decomposition of pyrite or pyrrhotite** by reaction of the ore with free chlorine or available chlorine in chlorine compounds, the pulverized ore is suspended in molten sulphur and the slurry chlorinated at a relatively low temperature (under 440° C). The sulphur is extracted from the sulphide mineral rapidly and economically, and a ferrous or other metal chloride is obtained. C. T. Hill, assigned to Texas Gulf Sulphur Co. March 1, 1960. Canadian 593,344.

**In the recovery of relatively pure nickel oxide** from mixed ores of nickel, copper, zinc, lead, etc., the ore concentrate is roasted at 700° C to reduce the sulphur content, the roasted material granulated, and the granules dried and chlorinated with diluted gaseous hydrochloric acid under such conditions that the copper, lead and zinc are volatilized and separated, and a nickel oxide product low in the other metals is recovered. T. G. Holst and K. O. R. Fureby, assigned to Reymersholms Gamla Industri Aktiebolag. March 8, 1960, Canadian 593,959.

**In a process for reducing iron ore concentrate without fusion,** a part of the divalent iron is converted to trivalent form and the ore ground and heated in an inclined rotary furnace in a reducing gas consisting mainly of carbon monoxide and at a temperature of 550-650° C. B. M. S. Kalling, assigned to Stora Kopparbergs Bergslags Aktiebolag. March 8, 1960. Canadian 594,094.

**In an economical and efficient process for the reduction of iron oxide ores,** the ore is continuously charged into a highly carburized iron melt in which the carbon is replaced as it is consumed. The molten iron which effects the reduction is sucked up in portions into an evacuated vessel, carburized in said vessel, and then returned to the melt. F. Harders, assigned to Dortmund-Hörder Hüttenunion A. G. March 8, 1960. Canadian 594,111.

**Design for a centrifugal bowl mechanism** for separating relatively heavy mineral particles from a slurry of ore, and collecting a mineral fraction while rejecting the gangue material. W. N. T. Morton. March 15, 1960. Canadian 594,188.

**In a method for effectively defiberizing asbestos ore** fiber bundles without impairing fiber length, a liquid dispersion of the bundles is treated with a wetting agent having an electrical polarity opposite to that of the asbestos; after a period of such treatment the bundles become defiberized. Chrysotile carries a positive charge, whereas the blue and amphibole types are negatively charged. W. Wilke, assigned to Rex Asbestwerke, Graf von Rex K. G. March 15, 1960. Canadian 594,371.

**In a process for recovering thorium from "barren" effluent liquor** resulting from the sulphuric acid leaching of uranium-thorium ores, such as those of the Blind River district of Canada, the ferric iron content is largely reduced to ferrous form, and tetra-sodium pyrophosphate is then added to precipitate thorium phosphate, which is recovered by filtration and dried. C. C. White, assigned to Rio Tinto Mining Co. of Canada Ltd. March 15, 1960. Canadian 594,395.

**In a process for recovering metal values,** particularly nickel (from laterites such as those of Cuba), serpentine and similar types of ore, the ore is ground, dried and chloridized with a gaseous mixture of hydrogen chloride and water vapor at a temperature of 400-600° F under critical conditions to form nickel chloride but not ferric chloride. The material is cooled, leached with water and separated into a solid fraction containing iron oxides and gangue and a solution containing chlorides of nickel, cobalt, manganese and magnesium. The solution is evaporated, and the solids contacted with a reducing gas comprising hydrogen, hydrogen chloride and water vapor, and leached to separate metallic nickel and cobalt from the remaining water-insoluble metal chlorides. Alternatively (No. 594,430), when cobalt is present in substantial amounts the chloride solution is extracted with 2-octanol, and the extract phase processed in like manner to recover metallic cobalt separately. M. E. Graham, W. A. Reed and J. R. Cameron, assigned to Republic Steel Corp. March 15, 1960. Canadian 594,429-31.

**In the separation of nickel and zinc from cobalt** in aqueous solutions obtained by sulphuric acid leaching of mixed ores of those metals, the inhibiting effect of zinc on precipitation of nickel is overcome by conducting the reaction in the absence of air or oxygen, suitably in an inert atmosphere or in a completely filled, closed reaction vessel. Zinc is precipitated along with the nickel, and it is not quickly oxidized back to zinc sulphate, which goes into the solution and interferes with nickel deposition. R. F. Matson, assigned to Freeport Sulphur Co. March 15, 1960. Canadian 594,418.

**Design for an improved apparatus** especially adapted to the cooling of fines screened from sintered iron oxide ores or like materials. The hot fines are progressively shaken down a helical vibratory conveyor from one grate to another countercurrent to a rising stream of cooling air. The fines are not entrained in the rising air, as occurs during blowing of a mixture of coarse and fine sintered particles. The screened out coarse material can be cooled by blowing in the usual manner. W. Zimmermann and J. Roeder, assigned to Metallgesellschaft A. G. March 1, 1960. Canadian 593,602.

**In the extraction of tungsten from scheelite,** an aqueous mixture of the ore and oxalic acid is treated with ammonia, and the resulting tungsten composition reacted with an oxalic acid-ammonia reaction product. The ammonium paratungstate solution thus formed is separated and decomposed to form tungstic acid. R. C. Osthoff, assigned to General Electric Co. March 1, 1960. Canadian 593,710.

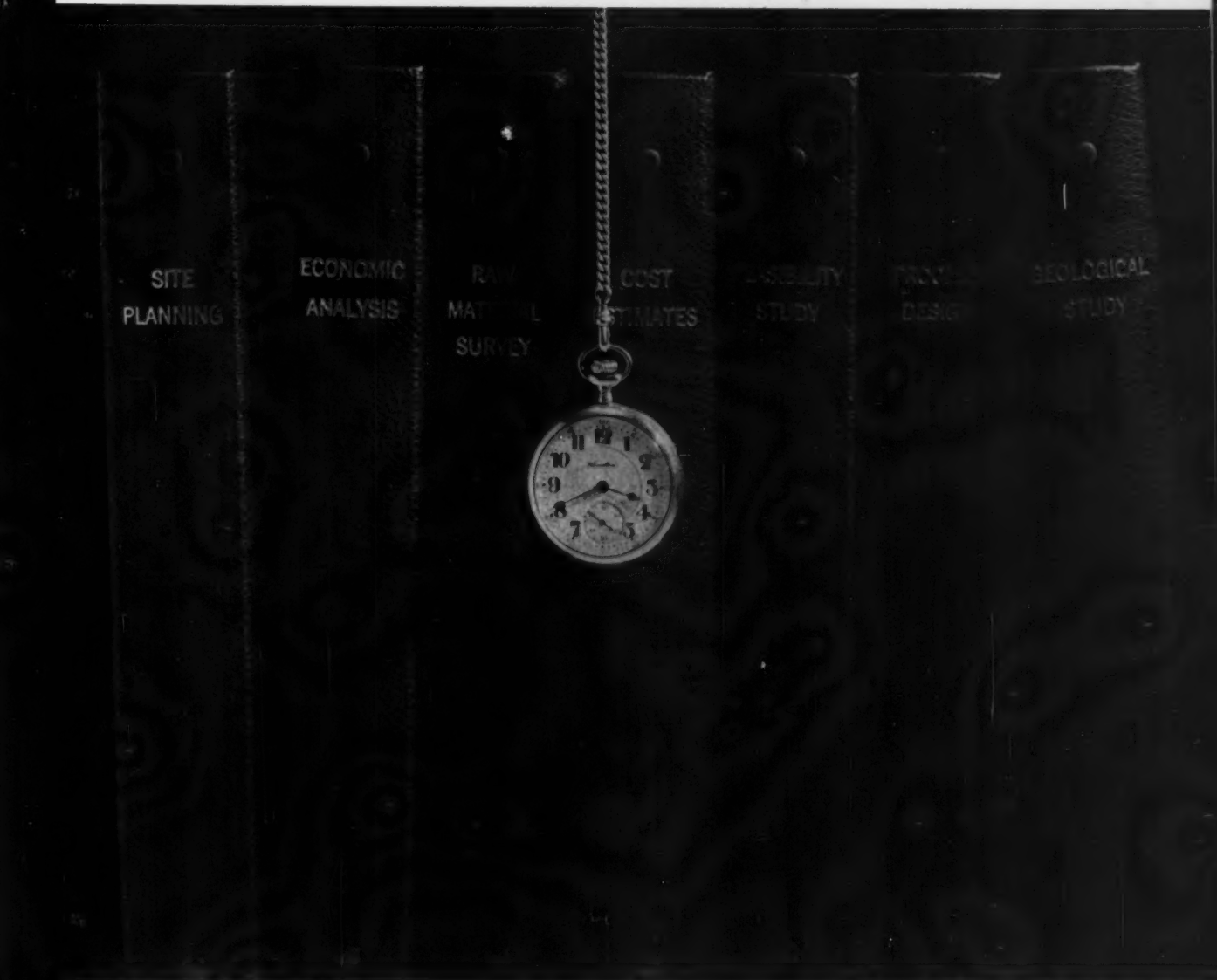
**To remove iron from unreduced iron-containing titaniferous ore concentrates,** the material is pressure leached with hydrochloric acid at a temperature of at least 175° C, and the solubilized iron component separated in the liquid phase, leaving a residue of titanium oxides. J. H. Bachmann, assigned to Columbia-Southern Chemical Corp. March 1, 1960. Canadian 593,362.

**Design for a device for taking ore samples** of predetermined quantity and at selected intervals, e.g. from an endless conveyor during loading of iron ore into vessels. The device advances with the moving belt, and may be controlled either manually or automatically. A. F. Blyth, assigned to Marcona Mining Co. March 1, 1960. Canadian 593,396.

**Method for treatment of ilmenite** to remove a major portion of the iron content and produce titanium dioxide. The ore is heated with a reducing agent and a flux so as to reduce about 80% of the contained iron to metallic iron. This iron is removed, and the remaining reduced ore mixed with additional raw ore, and the mixture sulphated and hydrolyzed. R. J. Wigginton, assigned to Laporte Titanium Ltd. March 1, 1960. Canadian 593,408.

**Copies of Canadian patents may be obtained by writing to the Patent Office, Ottawa, Canada.**

# Pre-Engineering by **KAISER ENGINEERS** answers basic plant expansion questions...

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## Dust and Fume Collection Systems

Whatever the need for dust or fume control, Norblo builds rugged, efficient equipment in Bag Type, Centrifugal and Hydraulic collecting systems. These three types, frequently used in certain combinations, provide economical dependable control as required in smelting, rock products, chemical, milling and processing fields.

Norblo engineers each installation from first hand experience of almost 50 years in many industries. High efficiency equipment having the correct factors to suit your needs includes the Norblo guarantee of performance, economy and low maintenance.

---

**Norblo Automatic Bag Type (Fig. 1)**

For continuous or heavy duty service providing very high efficiency at very low cost of operation and maintenance. Basic unit contains 78 bags 6″ diameter, 8′ 3″ long. Air flow is upward, from inside, thus keeping bags fully distended. Total free cloth area per compartment 936 square feet. Shaking and cleaning controlled by electric timer, is cyclic, one compartment at a time, each having its individual compressed air (or mechanical) shaker mechanism and the whole system variable and adjustable for dust load without shutting down. Any compartment can be cut out without affecting others. Access to interior is on the clear air side. *Bulletin 164.*

**Norblo Standard Bag Type**

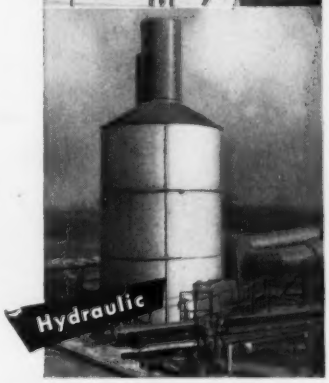
For intermittent service, as fan and unit must be shut down for cleaning, usually at noon hour and end of working day. Electrical or compressed air shaking and cleaning mechanism. Basic unit has 40 bags 6″ diameter, 8′ 3″ long, 480 square feet cloth area. In both Standard and Automatic bag types made by Norblo, extra large hoppers provide air expansion space resulting in great drop in air velocity and a maximum degree of dust separation by gravity before passing upward for final filtering. *Bulletin 163.*

**Norblo H. E. L. S. Centrifugal (Fig. 2)**

A cyclone or centrifugal type collector for all materials from sawdust to fly ash; characterized by high efficiency of collection with low static drop. The Norblo H. E. L. S. has no internal vanes, gadgets or dampers. High efficiency is obtained by scientific proportioning and by the patented (No. 2,259,919) expanding nozzle. These design features eliminate the power wasting back eddy. Built in standard sizes with capacity up to 37,500 cfm. *Bulletin 104.*

**Norblo Hydraulic (Fig. 3)**

A high efficiency, wet type collector, for separation of dust mixed with smoke or fumes. In most installations the Hydraulic unit is used with a Norblo Cyclone collector, thus reducing the amount of wet sludge to be handled. There are no moving parts. Filter beds are coke or high fired ceramic tubes, light in weight and kept in motion by ascending air stream so that beds are self-cleaning. Built in 11 standard sizes with capacities up to 26,000 cfm. *Bulletin 104-3.*

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**Norblo Portable Dust Collecting Units**

These are self-contained units for efficient, de-centralized dust collection. They are convenient, space saving, can be located close to the dust source. Made in six sizes in bag type with capacities from 300 to 1350 cfm. Several arrangements possible for clean-out facility. All models have 8″ static at fan. Fans exceptionally quiet. Two semiportable unit sizes available for intermittent service where required capacity is not large enough to call for the smallest. Norblo Standard Bag Type Dust Arrester. *Bulletin 162.*

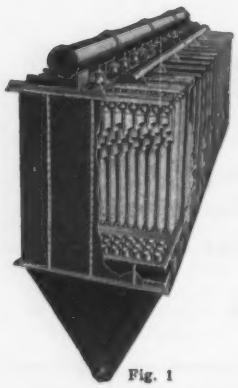


Fig. 1

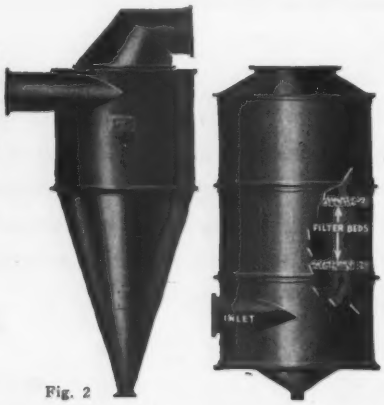
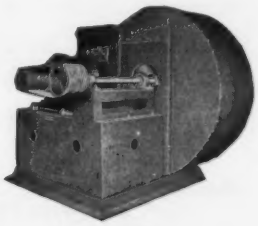



Fig. 2

**Norblo Exhaust Fans**

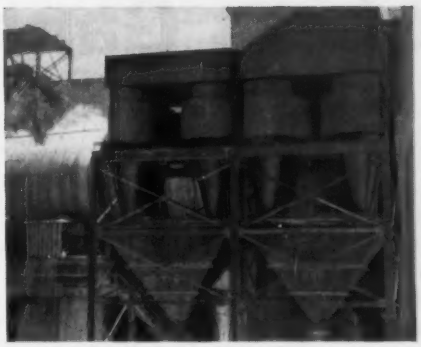
These high speed, low power fans have been developed especially for dust collecting systems and by proper wheel selection are adaptable to all types of material handling. All wheels are statically and dynamically balanced. Heavy duty bearings are standard equipment. *Bulletin 1002-6.*



*Individual illustrated Bulletins describing the above equipment available upon request.*

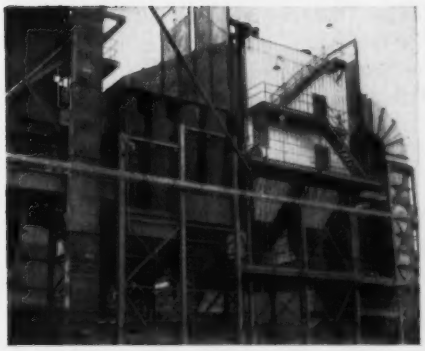
CYCLONE COLLECTORS
PRECIPITATORS
COMBINATION SYSTEMS
CLASSIFYING SYSTEMS

# Where extra efficiency counts... Industry specifies BUELL

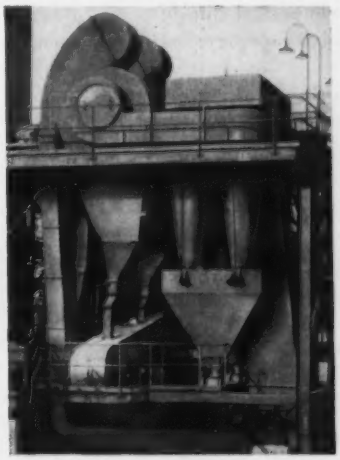


**Buell Cyclone Collectors** have the exclusive "Shave-off" design which utilizes double-eddy currents within the cyclones to trap an extra percentage of dust and minimize re-entrainment. Large-diameter design prevents bridging, clogging, or plugging. Extra heavy gauge construction contributes to long life. Buell-designed manifolding adds to efficiency of operation. Thoroughly described and illustrated in a booklet, "The Exclusive Buell Cyclone".

**Buell 'SF' Electric Precipitators** provide extra efficient recovery of dusts and lower maintenance costs year after year. The exclusive *Spiral-ectrodes* deliver 50 to 100% more electron emission than other types of emitting electrodes. Their self-tensioning characteristic minimizes electrode breakage. Buell Continuous Cycle Rapping practically eliminates "puffing". Positive Gas Flow Control through adjustable baffles assures maximum efficiency. Write for a copy of the extensively-illustrated booklet, "Buell SF Electric Precipitators".



**Buell Combination Systems** combine precipitators and cyclone collectors for the ultimate in profitable dust recovery. Buell Precipitators are unequalled in recovering fine dust particles, complementing the extra efficiency of Buell Cyclones. All three systems—cyclones, precipitators, and combination systems—are described in detail and thoroughly illustrated in a booklet, "The Collection and Recovery of Industrial Dusts".



**Buell Classifying Systems** are unique in operation, combining high efficiency with low power consumption and moderate capital investment. Patented features permit the separation of dry fine powdered or fibrous material from coarse material within a usual fine product range from 10 to 400 mesh. Systems are built in many sizes to handle from 100 pounds to 100 tons of feed product per hour without restriction on particle size or temperature. There are no moving parts. Power requirements vary from 0.04 to 0.5 fan hp per ton of feed per hour. A complete technical discussion is in a folder, "New Buell High Efficiency Classifying Systems".

•

buell Norblo

*For full information on the application of Buell equipment to your plant's dust problems, write Dept. 19-F, Buell Engineering Company, Inc., 123 William St., N. Y. 38, N. Y. Northern Blower Division, 6409 Barberton Ave., Cleveland, Ohio.*

*Subsidiary: Ambuco Limited, London, England.*

*Experts at delivering Extra Efficiency in* **DUST COLLECTION SYSTEMS**

# Recent Economic Growth — The Numbers Game

**If it truly portrayed recent rates of economic growth in the United States, the report on employment, growth and price levels recently issued by the staff of the Joint (Congressional) Economic Committee would point up scarcely less than a national disaster.** Among other things, it would document impressively Premier Khrushchev's crack that "the capitalist steed the United States is riding . . . is worn out."

One of the major findings of the Joint Committee's staff (in the Eckstein Report, named for its staff director Otto Eckstein) is that between 1953 and 1959 the average rate of growth of physical output in the United States was only 2.4 per cent per year. This is scarcely more than half the average annual rate of growth of 4.6 per cent the staff found to have prevailed between 1947 and 1953.

**Happily, however, the report does not reflect the basic economic realities.** Its finding on relative rates of economic growth for the two periods is a statistical *tour de force* which, by the selection of certain figures and certain dates, distorts the record of America's long-term economic growth.

## Playing The Numbers Game

By the selection of appropriate starting and terminal periods it is possible to document almost any rate of economic growth that is desired. The table at the bottom of this page shows you how this can be done. It will also show you how the Eckstein staff worked out its shocking contrast in growth rates. The table is built like a schedule of airplane fares between different cities. The postwar years 1946 through 1959 are put down on two axes. One runs down the left hand column, the other runs across the top of the table. Put your finger on the point where the two axes intersect and you have the average rate of growth for the period covered.

**ANNUAL AVERAGE GROWTH RATES OF THE U.S. ECONOMY, 1946-1959***

(Percent increases, starting year to terminal year, of GNP in 1954 dollars).

| Starting Year \ Terminal Year | 1946 | 1947 | 1948 | 1949 | 1950 | 1951 | 1952 | 1953 | 1954 | 1955 | 1956 | 1957 | 1958 | 1959 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1946 | X | –0.1 | –1.9 | –1.2 | 3.0 | 3.9 | 3.8 | 3.9 | 3.2 | 3.7 | 3.6 | 3.4 | 2.9 | 3.2 |
| 1947 | X | X | 3.8 | 1.8 | 4.1 | 4.9 | 4.6 | 4.6 | 3.7 | 4.2 | 4.0 | 3.8 | 3.2 | 3.5 |
| 1948 | X | X | X | –0.1 | 4.2 | 5.3 | 4.8 | 4.7 | 3.6 | 4.3 | 4.0 | 3.8 | 3.1 | 3.4 |
| 1949 | X | X | X | X | 8.7 | 8.1 | 6.5 | 6.0 | 4.4 | 5.0 | 4.6 | 4.2 | 3.5 | 3.8 |
| 1950 | X | X | X | X | X | 7.4 | 5.4 | 5.1 | 3.4 | 4.3 | 3.9 | 3.6 | 2.9 | 3.3 |
| 1951 | X | X | X | X | X | X | 3.4 | 3.9 | 2.0 | 3.5 | 3.2 | 3.0 | 2.2 | 2.8 |
| 1952 | X | X | X | X | X | X | X | 4.4 | 1.3 | 3.6 | 3.2 | 2.9 | 2.0 | 2.6 |
| 1953 | X | X | X | X | X | X | X | X | –1.6 | 3.2 | 2.8 | 2.6 | 1.6 | 2.4 |
| 1954 | X | X | X | X | X | X | X | X | X | 8.1 | 5.1 | 4.0 | 2.4 | 3.2 |
| 1955 | X | X | X | X | X | X | X | X | X | X | 2.1 | 2.0 | 0.5 | 2.0 |
| 1956 | X | X | X | X | X | X | X | X | X | X | X | 1.8 | –0.2 | 2.0 |
| 1957 | X | X | X | X | X | X | X | X | X | X | X | X | –2.3 | 2.0 |
| 1958 | X | X | X | X | X | X | X | X | X | X | X | X | X | 7.0 |
| 1959 | | | | | | | | | | | | | | |

*Compound rates of growth

Following this procedure, you can find growth rates ranging all the way from —2.3 per cent, between 1957 and 1958, to +8.7 per cent, between 1949 and 1950, along with almost any other rate you would choose for various years and sequences of several years over the postwar period.

For example, if you want to demonstrate that the postwar growth rate through 1953 was less than 4% per year, you take off from 1946, include a drop of 0.1 per cent between 1946 and 1947, and come up with a growth rate for the 1946-1953 period of 3.9 per cent. But if you want to show it was quite high, you take off a year later, from 1947 (which drops out that dismal —0.1 per cent for 1947) and come up with a fine growth rate of 4.6 per cent for the 1947-1953 years.

## Statistical Hocus-Pocus

That's what the Eckstein staff did. It took off at one end from a year when there was just about no growth, went to the Korean War boom year of 1953 at the other end, and got that average growth rate of 4.6 per cent. Then it took off from the Korean War boom year of 1953 and ran to the year 1959, when business was recovering from a recession and suffered through a steel strike of 116 days, to come up with its 2.4 per cent growth rate for the second postwar period. As the table indicates, by taking off a year later (1954) the average growth rate would have become 3.2 per cent, and if the take off had been 1949 it would have been 3.8 per cent.

**There are those who, in nontechnical terms, would characterize this as statistical hocus-pocus. There are also those who would see in it an element of political hocus-pocus, too.** This is because the years 1947-53, when the Eckstein staff found there had been the healthy 4.6 per cent growth rate, were roughly years when we had a Democratic president, while the anemic growth rate of 2.4 per cent it calculated for the subsequent years was for years of a Republican presidency.

Actually it can be shown that the civilian part of our economy has had more rapid growth during the Republican administration than it had during the Democratic years. If military expenditures are subtracted from the national ouput, the resulting growth rate for 1953 to 1959 is slightly higher than for 1947 to 1953.

However, we do not question the *bona fides* of the Eckstein staff. **But we do assert that it has produced a statistical picture of the postwar growth of the American economy which is dangerously misleading both at home and abroad.**

Abroad, the report appears to give official documentation to the propaganda line that the Soviet economy is running rings around the U.S. economy in growth, and that it is Communism a country should choose if it really wants to develop rapidly. Building on a much smaller economic base than the U.S.A., the Soviet Union — as well as almost every less advanced nation in the world — is bound to show a larger percentage increase in output than the U.S.A. But the Eckstein staff calculation gives the Communists ammunition they don't deserve.

## Are We Facing A Crisis?

The contrast drawn by the Joint Committee staff in postwar U.S. growth rates suggests that we are facing scarcely less than a crisis through paralysis of our economic growth which calls for drastic remedies. But this, as the full 1947 to 1959 growth record set forth in the table makes clear, is very definitely not the case. Our over-all postwar rate of growth, as measured by the gross national product in physical terms, has been 3.5 per cent per year, a rate nearly double the long-term growth rate of 2 per cent per year between 1909 and 1939. In the continuing fluctuations in the rate of growth which more or less inevitably characterize a relatively free economy, we have had some downs in recent years. **But our economy is now on the upbeat again. And at the end of this year, the U.S. economic growth rate for the postwar period can be expected to be 3.7 per cent per year.**

**It is extremely important for the United States to continue to maintain this rate of economic growth or even to surpass it.** Upon this effort depends our capacity to meet our defense requirements without dangerous strain, to provide an adequate margin for foreign aid, to improve our own productive facilities, and to continue to raise our own standard of living.

How not only to maintain but possibly improve upon our postwar pace of economic growth will be the subject of strenuous debate in the months ahead. However, the debate will have a much better chance of being constructive if the postwar growth record is seen in proper perspective. To this end one of the first things to do is to junk panic rousing statistical portrayals such as that in the Eckstein report.

*This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nation-wide developments. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or parts of the text.*

Donald C. McGraw

PRESIDENT

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Unique slag handling conveyor system utilizes 334 Barber-Greene ball bearing idlers, not one of which has yet been replaced. Photo shows slag being reclaimed from stockpile and loaded into travelling hopper-feeder.

# "MOVING SIZZLING SLAG OVER BELTS

Slag is dumped from ladle cars at 2000°F., sprayed with water, and cooled five days before being transferred to stockpile by clamshell.

Entire 924' two-unit slag handling system was engineered, fabricated, and erected by Barber-Greene, assuring the customer of undivided responsibility for satisfactory performance.

Standard Barber-Greene gallery truss is used to span six railroad tracks in one hop. Remaining tracks are spanned by standard 42" deep truss.

Inclined conveyor utilizes standard Barber-Greene 6" channel frame at tail end for most efficient loading height and 24" heavy-duty truss on incline to give longer spans between supports.

# CUTS HAULAGE COST AT LEAST 40%"

## "Our Barber-Greene belt conveyors have performed wonderfully, handling up to 28,000 tons monthly," reports W. R. Moore, Jr., Cleveland Slag official

Lowest cost and most dependable haulage are dual benefits the Cleveland Slag Division of Standard Slag Co. gets with its heavy-duty two-unit 924' long Barber-Greene belt conveyor system that moves slag from stockpile to the crushing plant of this Cleveland aggregate producer.

W. R. Moore, Jr., assistant general manager, relates, "Our Barber-Greene system has performed wonderfully in handling up to 28,000 tons of 200-300°F. slag monthly since installation in 1957. Initially, the conveyors cost about the same as trucks, which were also under consideration. However, our studies have shown that the belts cut haulage cost at least 40% over what it would have been with trucks."

**Flow Pattern**—Molten slag is received here in ladle cars from nearby Jones & Laughlin furnaces and dumped into cooling pits, where it is sprayed with water before being moved by clamshell to the stockpile alongside the conveyor. A second clamshell then loads the slag into a mobile hopper-feeder mounted over the 556' long inclined conveyor.

Atop the incline, the slag is transferred to a 365' long conveyor that speeds it across the railroad tracks and into the crushing plant, where it is reduced to lightweight building aggregates.

**Hopper-Feeder Moves 407'**—One of the unique design features of this installation is the Barber-Greene self-propelled hopper-feeder that straddles the horizontal portion of the inclined conveyor. Its 407' travel length permits building of a long stockpile beside the conveyor that can be easily reclaimed with minimum crane movement.

The same engineering skill that solved this tough problem for Cleveland Slag is ready to go to work for you. Your Barber-Greene conveyor specialist will gladly explain how standardized components, specially engineered components, or a combination of both can bring increased efficiency and lower costs to your job.

Barber-Greene hopper-feeder, designed especially for this job, travels 407' along stockpile under own power.

*Your belt conveyor equipment headquarters*

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**CONVEYORS • LOADERS • DITCHERS**

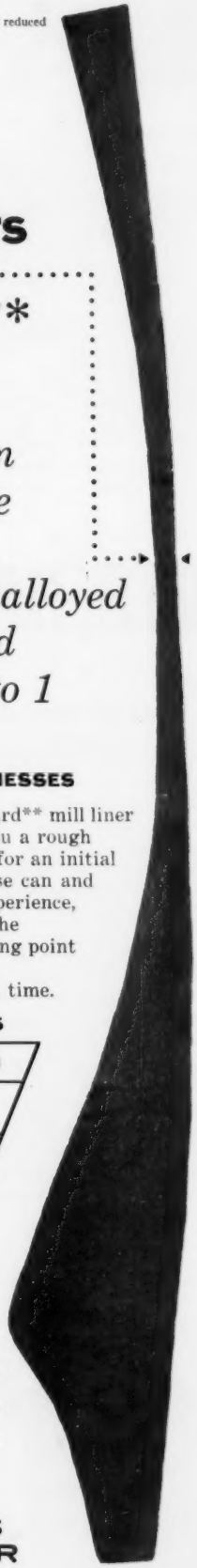
**ASPHALT PAVING EQUIPMENT**

Photos slightly reduced

# NI-HARD mill liners

## ...good to the last ¼"*

*Original liner 3¼" minimum thickness. Worn to ¼" before replacement. No breaking. No cracking. Outlasted unalloyed white iron 2.15 to 1 and manganese steel 1.46 to 1*



### MILL LINER MINIMUM THICKNESSES

If you are unacquainted with Ni-Hard** mill liner segments, the table below will give you a rough guide to the minimum thicknesses for an initial installation. Thinner liners than these can and are being used based on individual experience, but the thicknesses contained in the chart are suggested as a starting point for the mill man who is thinking about using Ni-Hard liners for the first time.

**MINIMUM MILL LINER THICKNESS**

| MILL DIAMETER | SIZE OF GRINDING BALLS OR RODS | | | |
|---|---|---|---|---|
| | 1" | 2" | 3" | 4" |
| 6 | 1.5" | 2.0" | 2.5" | 3.0" |
| 8 | 1.75 | 2.25 | 2.75 | 3.25 |
| 10 | 2.0 | 2.5 | 3.0 | 3.5 |

"Ni-Hard mill liner segments are available from authorized producers throughout the country. For the address of the one nearest you, write to Inco."

*Case histories on request **Registered trademark

**THE INTERNATIONAL NICKEL COMPANY, INC.**

67 Wall Street INCO New York 5, N.Y.

# NI-HARD

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

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CWD-221—35 TON CAPACITY

CW-220—20 CU. YDS. STRUCK

CWD-214—25 TON CAPACITY

CW-215—15 CU. YDS. STRUCK

CWD-321—35 TON CAPACITY

CW-28—8.2 CU. YDS. STRUCK

CWT-30—30 CU. YDS. STRUCK



CW-320—20 CU. YDS. STRUCK



CWT-8—8 CU. YDS. STRUCK

### Easy Operation— High Production From C-W Performance Features

Right through the Curtiss-Wright scraper line you find the "extras" that provide top production on any application, any terrain. The constant live power control unit gives you complete control of the bowl at all times . . . Exclusive Roto-Gear steer makes operation easy even on the big 26 cu. yd. CW-226 . . . Positive roll-out ejection gives you fast, smooth operation at the fill area . . . C-W loading characteristics assure top bowl factors on every pass . . . C-W balance provides excellent high-speed control on the haul road. These features and many others make Curtiss-Wright the outstanding performer in any capacity range.

C-W SERVICE A worldwide network of distributors and strategically located parts depots assure Curtiss-Wright users of fast, efficient service on any job location.

### A C-W MODEL FOR EVERY APPLICATION

Five self-propelled scrapers with capacities from 8 to 26 cu. yds. struck, up to 36 cu. yds. heaped . . . Three interchangeable rear dumpers with 25 and 35 ton capacities . . . Six tractor-drawn scrapers with capacities from 8 to 30 cu. yds. struck, up to 39 cu. yds. heaped . . . A total of 14 high-performance machines covering the complete range of practical earthmoving applications.

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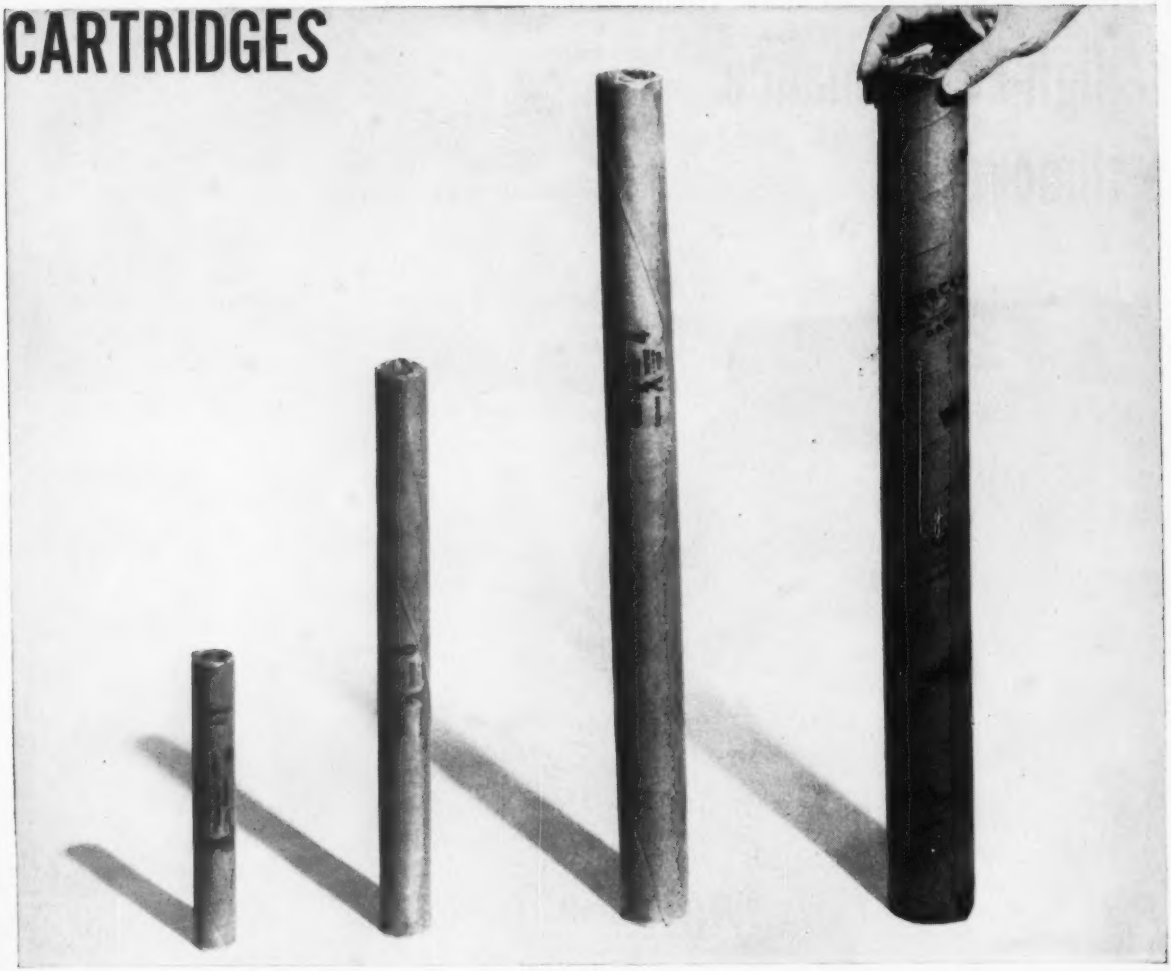
# HERCOL®—A LOW-COST EXPLOSIVE—NOW AVAILABLE IN SMALL-DIAMETER CARTRIDGES



The Hercol series of low-cost, cap-sensitive, high-ammonia-content explosives are now available in cartridges of small diameters and standard lengths, as well as in the larger diameters and special packings.

The ability of Hercol to produce excellent fragmentation, its water resistance, Class 1 fumes, and high cartridge count—plus its low cost—have already been proved to the economy-minded quarry and open-pit operator.

Now that Hercol is manufactured in the smaller diameters, with Class 1 fumes, these same economies are available to the underground operator.

Contact the Hercules sales office nearest you or ask your Hercules representative for more detailed information on how Hercol can reduce blasting costs for you, too.

**Properties of Hercol**

| | Hercol | Hercol 2 | Hercol 4 | Hercol 6 |
|---|---|---|---|---|
| Fumes | Good | Good | Good | Good |
| Cartridge count—1¼ by 8-in. cartridges per 50 lb. | 130 | 120 | 140 | 165 |
| Cartridge diameter, in. | 4 to 8½ | 1 to 3½ | 1 to 3½ | 1 to 3½ |
| Weight strength, % | 70 | 68 | 68 | 68 |
| Cartridge strength, % | 48 | 50 | 34 | 19 |
| Water resistance | Fair | Good | Fair | Fair |

A special grade of Hercol is formulated for seismic "pattern shooting" when the drill-holes are relatively dry.

*Explosives Department*

*HERCULES POWDER COMPANY*

INCORPORATED

*900 Market Street, Wilmington, Delaware*

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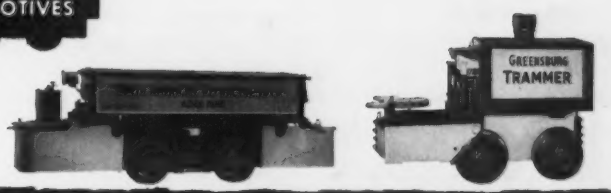
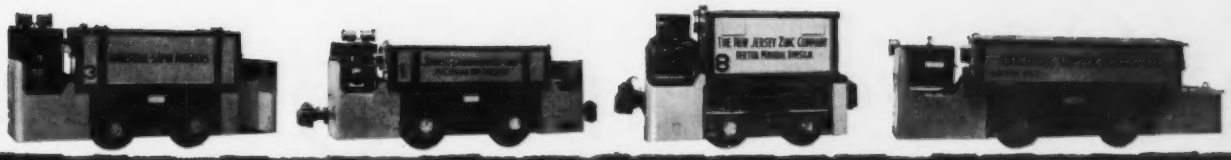
# National Mine Service Company

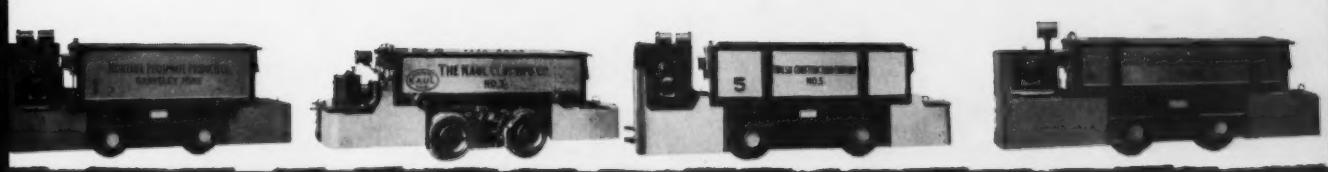
GREENSBURG MINE LOCOMOTIVES



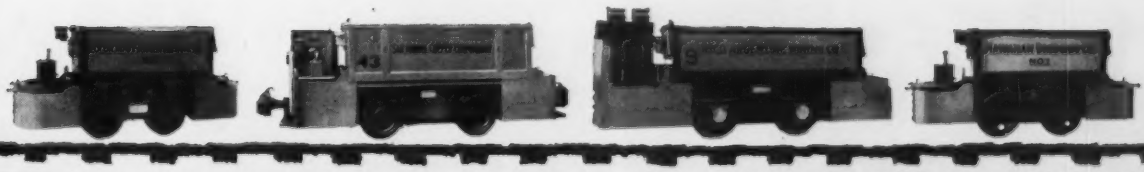

## SERVING THE MINING INDUSTRY EVERYWHERE—
## THE GREENSBURG DIVISION



## MANUFACTURING, SELLING AND SERVICING
## THE FAMOUS GREENSBURG LOCOMOTIVES



GREENSBURG MONITOR—a great name in mine locomotives—is now an integral division of NATIONAL MINE. The complete range of Greensburg Monitor Storage Battery Locomotives, from 2 to 15 tons, is backed by the service of National Mine in every major mining area. When you want *more pulling power per ton*, with longer battery life and higher efficiency for every invested dollar, check the facts with National Mine!



**National Mine Service Company**

KOPPERS BUILDING, PITTSBURGH 19, PA.

IN CANADA: NATIONAL MINE SERVICE (CANADA) LIMITED, Elliot Lake, Ontario

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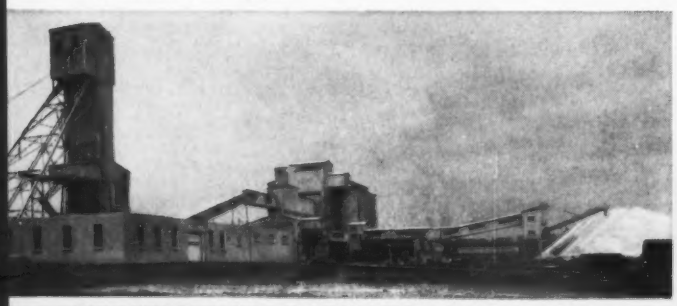
# Pass the salt...

# from 2,000 feet below Lake Erie

# ...a job for USS Tiger Brand

Fairport Harbor Mine of the Morton Salt Company showing skip hoist at left and processing plant at right.



Rock salt discharges from the skip into a hopper and then flows on to a conveyor leading to the processing plant.

Skip hoist equipped with two Tiger Brand wire ropes. Two skips operate simultaneously—one discharges at the top while the other loads at the bottom.

The deepest salt mine in the United States is located at Fairport Harbor, Ohio, about 25 miles northeast of Cleveland. It taps a vast bed of salt 2,000 feet below the surface and extending far under Lake Erie. This is the first mine of its kind built in this country in the last 25 years. The shaft is deeper than the height of the Empire State Building.

Geologists estimate that the high-grade rock salt in this location will last over 200 years. The Morton Salt Company of Chicago, developers of the mine, aim to produce about 500 tons of salt an hour. All of it will be used for industries in the East and Midwest and for spreading on highways and sidewalks in winter.

USS Tiger Brand Wire Rope forms the vital connecting link between the salt bed and the surface. Two huge skips, shaped like rockets, have a capacity of 16 tons each and make 31 trips per hour. They are hoisted at a rate of 1,380 feet per minute by two Tiger Brand $2\frac{1}{8}$" dia. Special Mine Hoist Ropes 2,580 feet long. These ropes provide the strength, fatigue and abrasion resistance necessary for safe and economical service. To prevent corrosion from the salt, the ropes are thoroughly lubricated at the factory and are relubricated every month at the mine.

**Why USS Tiger Brand is your best buy.** Tiger Brand Wire Rope is designed by one of the industry's most capable staffs of wire rope engineers. It is made by a company that maintains the most complete research and manufacturing facilities in the steel industry. When you buy Tiger Brand you get the right rope for the job. And your installation is no further away than a phone call from experienced American Steel & Wire field service representatives.

For more information, write American Steel & Wire, 614 Superior Ave., N.W., Cleveland 13, Ohio.

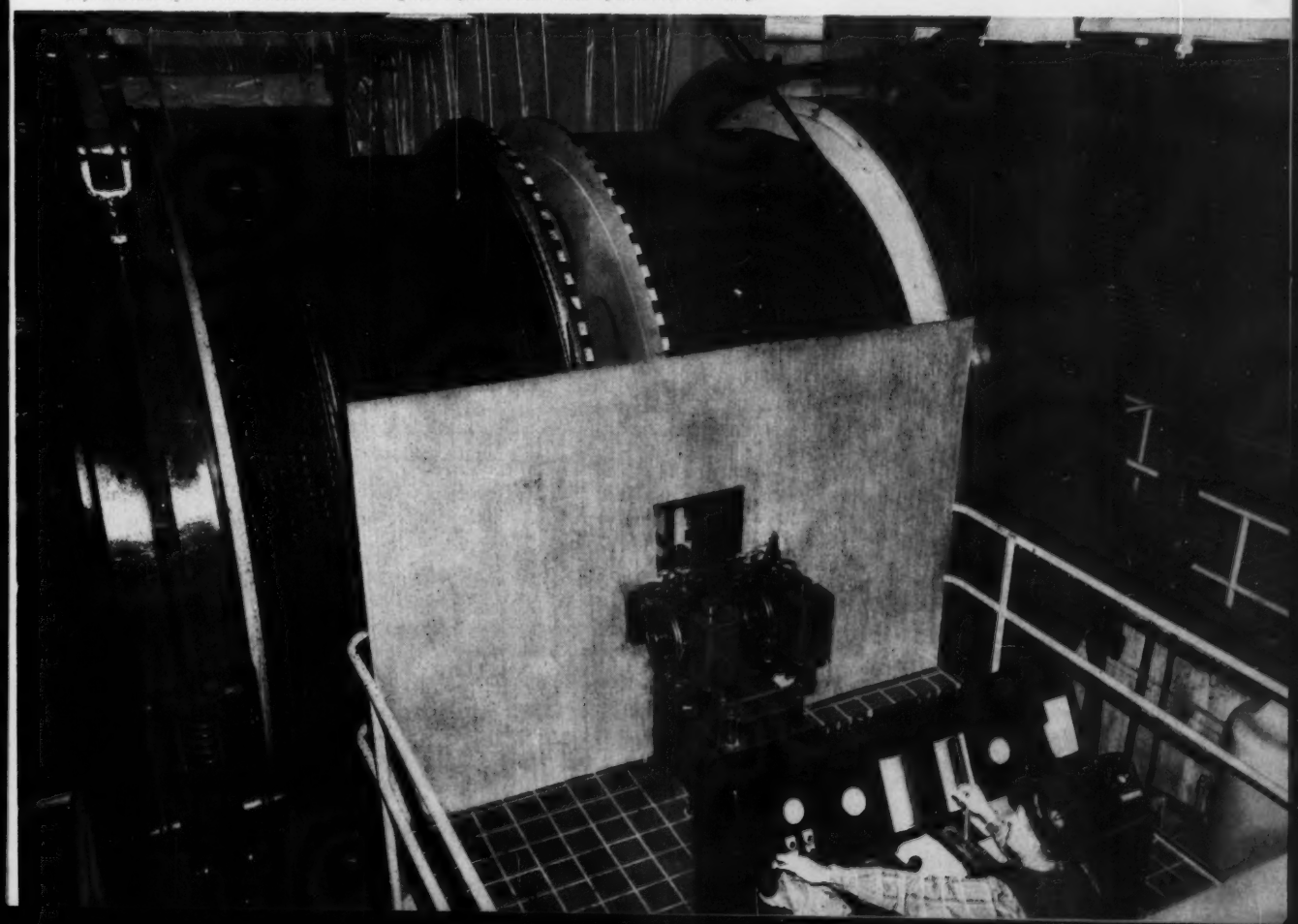
*USS and Tiger Brand are registered trademarks*

USS **American Steel & Wire Division of United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
Tennessee Coal & Iron Division, Fairfield, Alabama, Southern Distributors
United States Steel Export Company, Distributors Abroad

# Wire Rope

USS Tiger Brand Wire Rope on the huge 12-foot diameter skip hoist drums. Skip operator can tell when skip is loaded by a series of different colored lights. Depth indicators show position of each skip.



Foxboro pH Dynalog Recorder has an input impedance of 80,000 megohms — eliminates the need for intermediate amplification. Span is adjustable from 2-12 pH; zero, from 0-12 pH.

# pH Recording and Control without need for amplification

## less drift, less cost, less maintenance, too!

Foxboro pH Dynalog Controller — for use where it is desired to hold pH at a predetermined value.

Foxboro pH Dynalog Indicator — for use where complete record of pH value is not required.

THAT'S RIGHT — the intermediate amplifier is gone from Foxboro's new low-cost system for measuring pH. And gone with it is the wasted panel space, the drift, the daily standardization inherent with earlier systems.

In the new Foxboro system, the signal from the pH electrode goes direct to a high impedance Dynalog* receiver — without intermediate amplification. Signal operates a direct-reading indicator or recorder—or a controller and alarms, when desired.

The new Foxboro pH system is the simplest, most economical method of measuring pH available today. Ask your Foxboro Field Engineer to tell you about it. Or write for data sheet. The Foxboro Company, 196 Norfolk Street, Foxboro, Massachusetts.

*Reg. U.S. Pat. Off.

**FOXBORO** Analytical Instrumentation

REG. U. S. PAT. OFF.

# MAGOR

## ...for dependable surface mining..

Magor Automatic Air Dump Cars have set the pace for years throughout the mining industry for fast, efficient low cost service. Magor Cars are specially designed and built to take the rough, tough treatment of mining operations.

Through less maintenance, longer operating life and all 'round dependability, Magor Air Dump Cars save time and money on the job. An outstanding reason why Magor built automatic air dump cars are high on the preferred list of the nation's mining interests.

The 43 cubic yard, 100 ton capacity Air Dump Car shown here is but one of a large quantity recently furnished for a Taconite Mining operation in Minnesota. This car is equipped with a replaceable floor wearing surface of 1" thick low alloy, high tensile steel bars. These bars together with the 3/4" low alloy, high tensile steel floor afford the necessary strength to withstand the punishment of the hard rugged Taconite service.

MAGOR CAR CORPORATION

*Designers and Builders for the Mines & Railroads of the World*

50 CHURCH STREET, NEW YORK 7, N.Y.

*MANUFACTURERS OF:*

AIR DUMP CARS • ORE CARS • GONDOLA CARS • FLAT CARS • SPECIAL PURPOSE CARS • COVERED HOPPER CARS • HOPPER CARS • BOX CARS

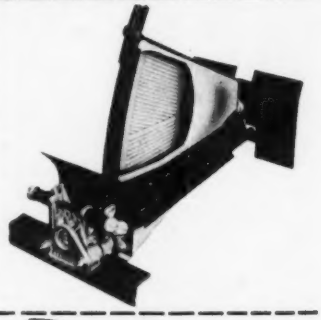
# 3 NEW WAYS TO INCREASE FILTER CAPACITY AND LOWER YOUR COSTS . . .

**CONTOUR SCRAPERS**

*Increase Disc Filter Capacity . . Lower Cake Moisture . . Increase Bag Life*

A flexible rubber blade contours with the filter bag, as it bellows for cake discharge. Thus discharging all of the cake EVERY REVOLUTION OF THE DISC. There's no refiltered cake to produce "high moisture" lumpy cake. This means you can either increase filter capacity, or handle present tonnage at slower disc speeds . . . increase your dry time and lower cake moisture. You can even discharge thin cakes at higher disc speeds. Also because of the Contour Scraper's gentle blade pressure on the cloth and their self aligning feature, bag life is increased . . . WRITE FOR BULLETIN CS-102.

AVAILABLE FOR DISC FILTERS from 3' Dia. Discs to 12' 6" Dia. Discs

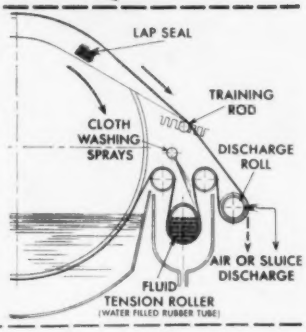


**CLOTH DISCHARGE FILTER ("Cloth Discharger")**

*Prevents Cloth Blinding . . Discharges Very Thin Cake*

The "Cloth Discharger" continuously removes the fabric filter medium from the rotating drum, cleans it thoroughly with a solution or air jets (see left) then automatically replaces it back onto the drum, for unattended operation. A water-filled, flexible rubber tube or "Fluid Tension" roller provides uniform tension for virtually each thread of the cloth. The filter prevents internal cloth blinding. Cakes too thin for other filters are completely discharged without blow back, and fast drum cycles can reach ultimate capacity . . .
WRITE FOR BULLETIN CD-103.

AVAILABLE FOR FILTERS from 3' Dia. x 1' Pilot to 11' 6" Dia. x 18'

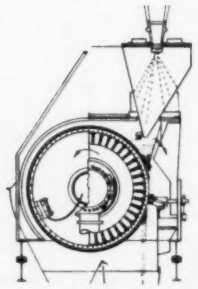



**TFR - TOP FEED RESERVOIR FILTER**

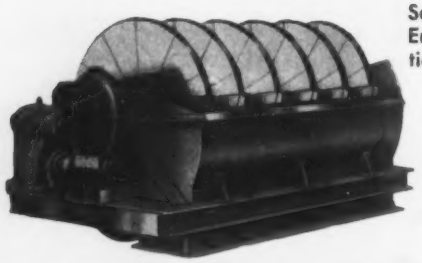
*Top Feed Filter with a Reservoir and Overflow . . 85% Effective Area . . no "blow-back"*

The reservoir seal is made by solids which settle in the pinch between the drum and the heavy rubber flap. A wide overflow weir can take all of the feed without overflow into the dry cake. High frequency vibration which is transmitted to the cake from a drum deck mounted in rubber, is available. The cake is discharged under vacuum by "Seal Lock" scrapers that cover and seal the narrow compartments . . . with no blow-back. The cake falls straight down and away from the drum without obstruction of additional conveying device . . .
WRITE FOR BULLETIN TFR-104.

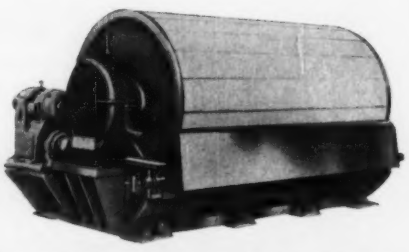
AVAILABLE IN SIZES from 3' Dia. x 1' Pilot to 8' Dia. x 12'



ONLY PETERSON DISC FILTERS offer exclusive Contour Scrapers and T.P.A. (Top-Entering Propeller Agitation).



ONLY PETERSON DRUM FILTERS offer the simple, no gadget, "Cloth Discharger".



**IT WILL PAY YOU TO INVESTIGATE THESE AND OTHER PETERSON FILTER PRODUCTS. WE'LL BE HAPPY TO DISCUSS YOUR SPECIAL FILTERING PROBLEM . . . WRITE . . .**

**PETERSON FILTERS**
**AND ENGINEERING COMPANY**
P. O. BOX 606 • 1949 SOUTH 2nd WEST STREET • SALT LAKE CITY 10, UTAH

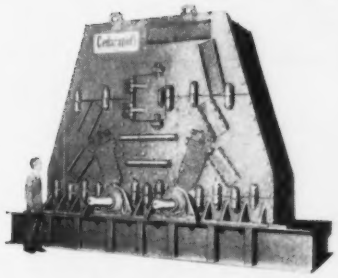
Want lowest cost per ton? . . . buy

# Cedarapids

Built by IOWA

## Heavy-Duty Equipment for Reducing Processing Costs

When the equipment you use in processing ore bears the Cedarapids Trademark, you can be *sure* of design, engineering, and quality construction that consistently gives the lowest possible cost per ton in crushing, screening and handling operations. With Cedarapids equipment you get *extra strength* built in for heavy-duty service . . . heat treated crusher bases and screen boxes, rigid rib reinforcement, larger than average eccentric shaft, etc. Each Cedarapids unit is skillfully engineered for *extra hourly tonnages* . . . among the many capacity-increasing features are overhead eccentric forced feed jaw crusher design, heavier-than-average flywheels, more efficient feeding methods, horizontal screen design. And "service-proved" low maintenance is another Cedarapids benefit that helps you get lowest cost per ton. It will pay you to investigate Cedarapids advantages thoroughly. Write for literature.



**DOUBLE IMPELLER IMPACT BREAKERS**

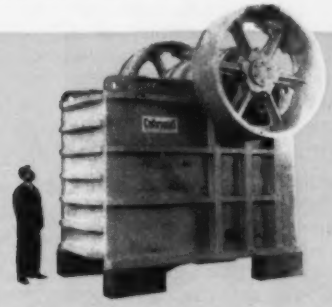
In increasing use for crushing a wide variety of minerals from calcite to zinc ore. Exceptionally high capacity, plus high reduction ratios which often eliminate the need for other secondary crushers, makes these Impact Breakers profitable for your mining operations. Six models, from 22" x 22" to 53" x 60".

**IOWA MANUFACTURING COMPANY**

**Cedar Rapids, Iowa, U.S.A.**

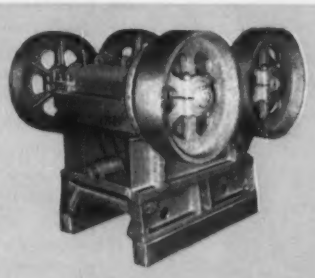
*SEE YOUR NEAREST CEDARAPIDS DISTRIBUTOR FOR FULL DETAILS*

2359N



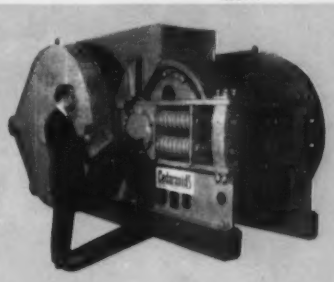
**SINGLE-JAW CRUSHERS**

Proper eccentric throw, angle of toggle and proper RPM are balanced for extra crushing capacity. Single-Jaw Crushers available in a wide range of sizes from 42" x 48" to 10" x 16".



**TWIN-JAW CRUSHERS**

A Cedarapids exclusive design! Two movable synchronized jaws, operating at high speed, give you 40% to 100% higher primary crushing capacity than single-jaw crushers of the same size.



**ROLL CRUSHERS**

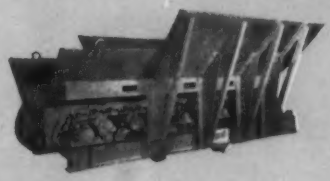
Where high capacities of fine crushed products are required, Cedarapids Roll Crushers are ideal units for secondary reduction. 8 sizes available with several types of roll shells.

**HORIZONTAL VIBRATING SCREENS**

*Horizontal* screen cloth openings permit more of the correct size material to go through, yielding 30% more capacity than inclined screens of the same size. Sizes: 3'x8' to 60"x16', double and triple deck.

**HEAVY-DUTY SCALPING SCREENS**

Inclined double-deck vibrating screens are sturdily built to handle 2' to 3' material. Eccentric shaft vibrating mechanism provides positive circle throw that assures fast, clean separation in one pass.



**HEAVY-DUTY APRON FEEDERS**

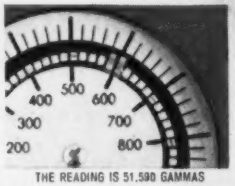
Especially designed for smooth feeding of heavy, large-sized material. Rugged construction, with 9 shafts beneath the heavy cast flights, withstands shock of dumping heavy material into feeder.

# DIRECT READING MAGNETOMETER THAT IS PORTABLE AND FAST

**The Varian M-49 provides a maximum of magnetic data in a minimum of field time**

**The data is read off as an absolute value without further computation**

The Varian M-49 is a 16-pound instrument easily carried over a man's shoulder. Every six seconds it gives an absolute reading of earth's magnetic field at the spot where he stands. No leveling or special orientation is needed. The reading is in gammas, accurate to plus or minus 10. Over the instrument's entire range from 19,000 to 101,000 gammas, the reading is absolute and requires no reference back to any standard. The instrument is drift free within its sensitivity specifications.



THE READING IS 51,590 GAMMAS

The Varian M-49 reveals variations in earth's magnetic field associated with faults and other subsurface structures, magnetic ore bodies, and magnetic phenomena coexistent with nonmagnetic ores. Exploration parties may now acquire magnetic data with great ease. It takes negligible extra time beyond that required for their other observations. Correlating these magnetic data with other measurements and observations can reveal interrelations that will greatly assist the geophysical interpretation.

To achieve the unusual features of the M-49 Magnetometer, Varian uses the revolutionary proton free-precession principle which relies on an **unchanging nuclear constant** (of the hydrogen atom). Over one year of field use of the Varian M-49 has proven practical applicability of the instrument. Varian has built sensitive, light-weight magnetometers on this principle to go aloft in America's satellite program. Varian Magnetometers are also used extensively in aerial magnetic surveys covering tens of thousands of miles of the earth's surface.

*Write today for a full explanation of the Varian Magnetometer's principles, applications and equipment features and details. Address the Instrument Division.*

**VARIAN associates**
PALO ALTO **29**, CALIFORNIA

NMR & EPR SPECTROMETERS, MAGNETS, GRAPHIC RECORDERS, MAGNETOMETERS, MICROWAVE TUBES, MICROWAVE SYSTEM COMPONENTS, HIGH VACUUM EQUIPMENT, LINEAR ACCELERATORS, RESEARCH AND DEVELOPMENT SERVICES.

# 1500 FEET OF HOLE PER SHIFT*

## IN SEDIMENTARY AND ALLIED FORMATIONS

***... typical of the REICHdrill "750 Series" performance ... under difficult operating conditions.***

In metal or non-metallic mining, job performance records like this are standard with REICHdrills. These highly productive drilling units have built a reputation for keeping maintenance costs low ... footage records high. Why? Because:

... REICHdrill features include: fast, easy adjustment of rotary speeds and down-pressure for optimum penetration and bit life in all formations
... direct drive to drill stem that saves power loss
... no complicated transmission, no rotary table, no kelly means in and out of the hole faster
... instant safety torque release protects all drive components, saves rotary bits, core barrels and drill stem.

And these features help set performance records: masts incline for angle drilling; CP heavy-duty compressors meet all air demands; all controls are hydraulic ... operator relieved of "strong-arm" methods; CP "Air-Blast" Bits for extra footage in toughest formations.

*CT-750 Crawler-tractor mounted REICHdrill for blast hole drilling. Holes to 9 inch diam.; down-pressure to 45,000 lbs. Other REICHdrills, truck or crawler-mounted, for all open pit operations.*

*For further information write:*

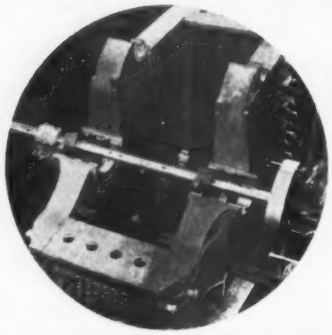
**REICHdrill**

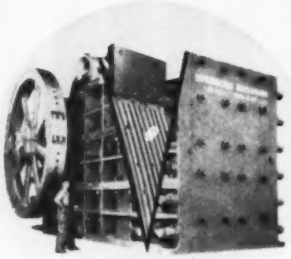
1442 BEECH STREET, TERRE HAUTE, INDIANA

Division: CHICAGO PNEUMATIC TOOL CO.

* Details on request

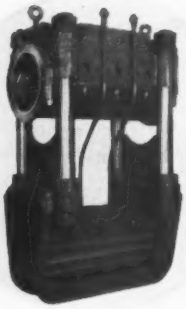
Deep, extra strong cast steel frames.

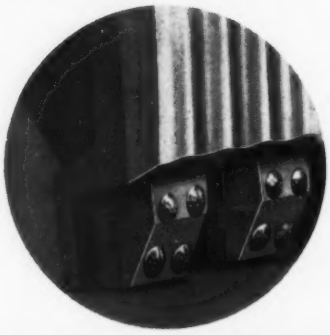




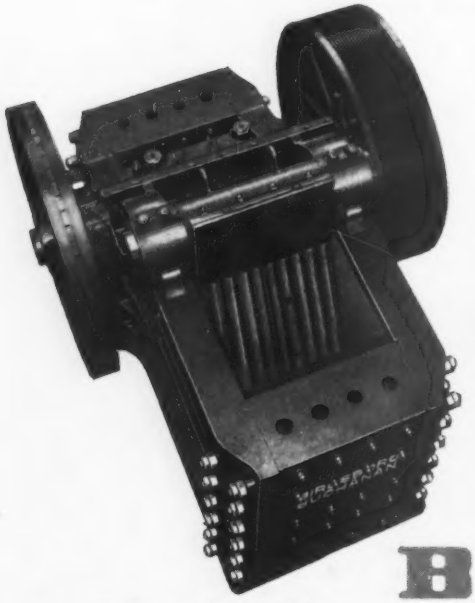
Longer, swing jaw for more acute crushing angle.

Rod type pitman, lighter and stronger, cuts power costs.





Offset toe lugs allow extra wear on jaw plates.



Entire crusher precision constructed for easy field assembly.

Interchangeable and reversible jaw plates for additional wear.

CR 28-60

**BIRDSBORO-Buchanan Primary Crushers**

# BIRDSBORO
## CORPORATION

STEEL MILL MACHINERY • HYDRAULIC PRESSES • CRUSHING MACHINERY • SPECIAL MACHINERY • STEEL CASTINGS
Weldments "CAST-WELD" Design • ROLLS: Steel, Alloy Iron, Alloy Steel • **BIRDSBORO, PENNSYLVANIA**

**Canadian Representative & Manufacturer: John Inglis Co., Ltd., Toronto, Canada.** *World-Wide Agent Representation.* Contact home office for nearest representative.

# Specialized chemicals for minerals– from Armour

*Armour Industrial Chemical Company offers a wide variety of chemicals for mineral applications—cationic flotation collectors, flocculants, and conditioning agents for hygroscopic materials.*

| Mineral applications | Recommended Armour Chemical |
|---|---|
| **Flotation:**<br>Silica from Phosphate Rock<br>Mica, Spodumene and Feldspar from pegmatites<br>Iron-bearing minerals from glass sands<br>Sylvite from Halite<br>**Bulk flotation:** Heavy minerals from beach sands | **Armac® T** (tallow amine acetate)—a technical grade amine salt between 95% and 102% neutralized. It is a medium-hard solid. At 25°C it can be used as a 5% water solution producing a pH of about 7. At this solution it is also an anti-caker of hygroscopic materials, even when applied to moist surfaces. |
| **Flotation:**<br>Silica from Phosphate Rock<br>Mica, Spodumene and Feldspar from pegmatites<br>Iron-bearing minerals from glass sands<br>Sylvite from Halite<br>**Bulk Flotation:** Heavy minerals from beach sands | **Armeen® T** (tallow amine)—a technical grade amine that is a medium-hard solid. It can be used straight when blended with frother or secondary collector (usually 2 parts amine to 1 part solvent). Or it can be used when neutralized with acetic acid or hydrochloric acid and solubilized in water. When heated to its free-flowing temperature, straight Armeen T functions as a conditioning agent for anti-caking hygroscopic salts or formulations. |
| **Flotation:**<br>Silica, Mica and Pyrite from Calcite or Kyanite<br>Silica from Iron Oxides<br>Monazite from a variety of heavy minerals | **Armac C** (coco amine acetate)—another technical grade amine salt between 95% and 102% neutralized. This one is a soft and pasty solid that can be used as a 25% water solution at 25°C. Armac C is recommended for applications in which mineral sizing is fine, or where sharp mineral selectivity is desired. |
| **Flotation:**<br>Silica, Mica and Pyrite from Calcite or Kyanite<br>Silica from Iron Oxides<br>Monazite from a variety of heavy minerals<br>**Flocculant:** Selective flocculant for negatively-charged particles | **Duomac® T** (tallow diamine di-acetate)—a diamine salt, about 100% neutralized, that is a soft and pasty solid. It can be used as a 20% water solution at 25°C. Duomac T is a stronger collector than Armac C and is capable of floating coarser mineral sizes. |

| Mineral applications | Recommended Armour Chemical |
|---|---|
| **Flotation:** Sylvite from Halite | **Armeen TD** (tallow amine, distilled)—the equivalent of Armeen T, but higher in primary amine content and a quite-hard solid. It is neutralized with acetic acid or hydrochloric acid, then solubilized to about a 5% water solution before use. |
| **Flotation:** Sylvite from Halite<br>**Conditioner:** Anti-caking agent for Sylvite | **Armeen HTD** (hydrogenated tallow amine, distilled)—a hard, waxy, completely saturated derivative of tallow amine. Less soluble and more inert than Armeen TD. As a collector, it is used as a 1% water solution of the acetate or hydrochloride salt. As a conditioner, it is melted and applied straight. |
| **Flotation:** Mica and Feldspar from pegmatites<br>Silica from Phosphate Rock | **Armoflote® 54-38 and 58-22** (amines in nitrogen-based solvents)—chemicals to be used straight in flotation circuits, blended with either the frother or secondary collector to aid their dispersion in the pulp. Armoflote 54-38 is liquid at 90°F, Armoflote 58-22 at 60°F. |

## New Product Applications

### Anti-caking—Anti-dusting

**Armoflo® 48 and 65**—Armour Armoflo 65 (cationic) and Armoflo 48 (anionic) are new formulations. Both are liquid at normal temperatures with melt points of 5°C or below. They are sprayed or dripped as received in applications for:

(1) the control of caking in hygroscopic salts, fertilizer mixes, or granular fertilizers.

(2) the control of dusting in plants where grinding or rolling systems result in abrasion of particles with subsequent dusting.

(3) the control of both caking and dusting where joint problems exist in fertilizer or hygroscopic salt plants.

Normal reagent consumption for the control of caking, or of both caking and dusting, is one pound of Armoflo per ton of product. For strictly dust control, the recommended application rate is 0.5 pounds per ton of product, or less.

Armoflo 65 is finding successful application with ammonium and potassium salts, and a wide variety of high analysis blended fertilizers. Armoflo 48 is recommended for application with sodium and calcium salts.

*Write us for samples and technical bulletins. Armour's Technical Service Department will also be happy to help you determine the proper chemical for your specific mineral need.*

**Armour Industrial Chemical Company**
©Division of Armour and Company
110 North Wacker Drive • Chicago 6, Illinois

# Dependable Haul Road Maintenance

IN TODAY'S MODERN MINES AND QUARRIES, good haul roads are important for top operating efficiency. Haulage units can deliver the load faster, have better fuel economy, less repairs and have greater operator and vehicle safety.

A Huber-Warco motor grader assures dependable haul road maintenance. These rugged graders are designed to maintain roads quickly and efficiently, even in extreme weather conditions.

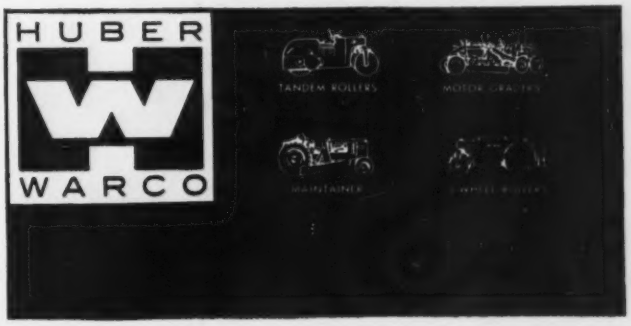
Heavy construction means years of dependable service with less downtime for repairs. Fast acting, full hydraulic controls give an operator complete blade control from the cab for grading, ditching, bank sloping and other grader functions.

There is a Huber-Warco motor grader to fit your needs – models include 85 to 160 horsepower standard transmission graders and 102 to 195 horsepower models featuring torque converter and powershift transmission.

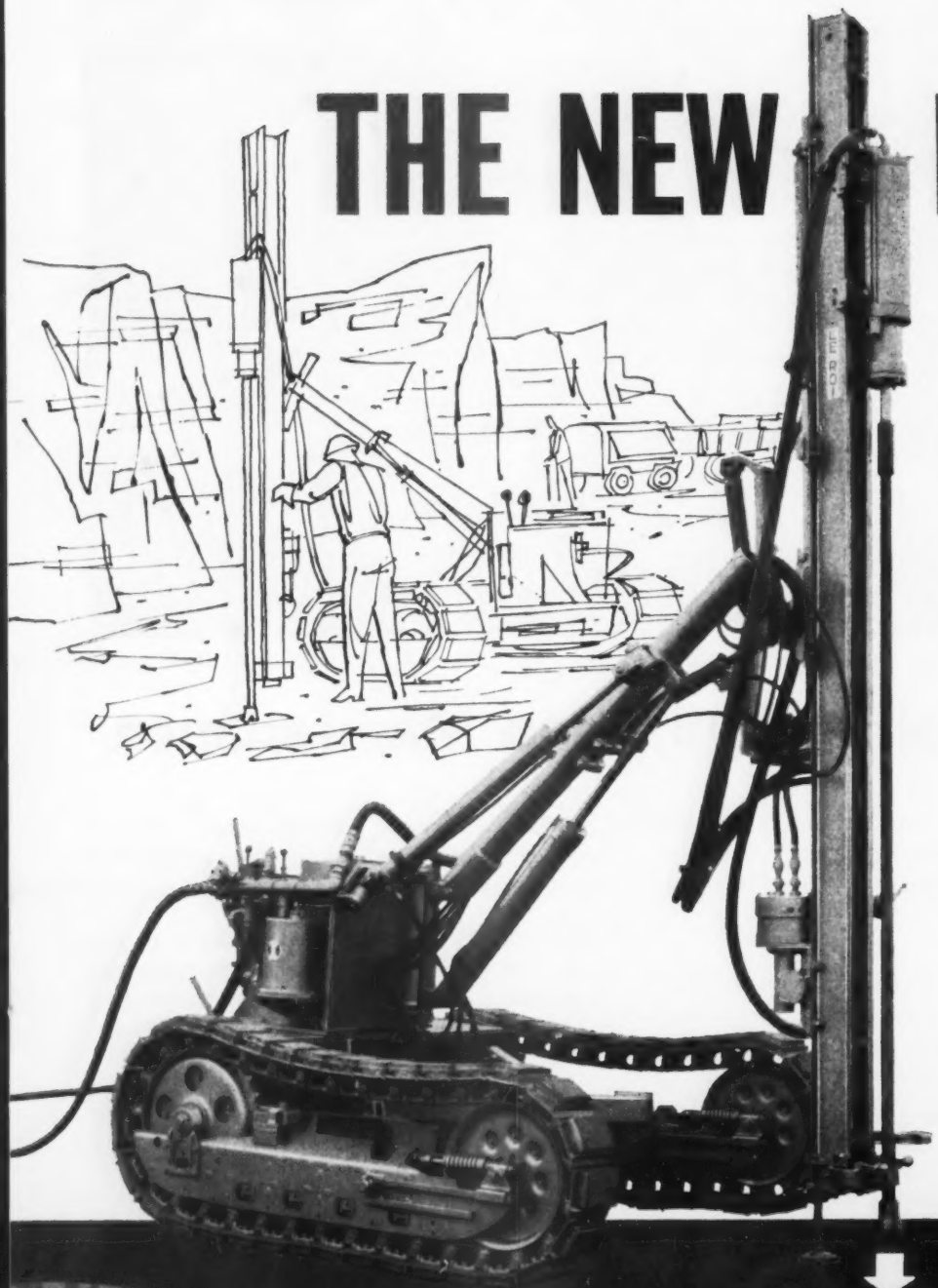
For dependable haul road maintenance see your nearest Huber-Warco dealer for the complete story.

**HUBER-WARCO COMPANY**

**MARION, OHIO**



# THE NEW LE ROI



puts
down
big
4 inch
hole
fast!

DOWN DEEP FOR MODERN DRILLING

Drills at any angle

# TRAC-NEWMATIC

. . . on uneven terrain

Here's Le Roi's brand-new, hardworking crawler drill — The Trac-Newmatic.

The Trac-Newmatic carries a big 5-inch drifter on an extra-sturdy air-powered feed shell . . . all mounted on a hard-lugging crawler that can pull a 600 rotary along with it over rough terrain.

The 5-inch drifter features a striking-bar design that efficiently squeezes every ounce of power out of the available air . . . minimizes leakage and blow-by . . . drills 4-inch hole fast. What's more, the drifter has forward, neutral, and reverse rotation to assure fast driving, easy extracting, and speedy steel-uncoupling or coupling.

An air-motor driven hydraulic pump is used to quickly position the feed shell for breast- or lift-hole drilling either straight ahead or over the tracks to give a wide drilling pattern from a single location. A standard model with hand-operated hydraulic pump to raise and lower the boom is also available.

Tramming is easy, too . . . two hefty 7½ hp reversible air motors give the Trac-Newmatic plenty of power, while the oscillating tracks permit tramming or parking even on irregular terrain. Controls are mounted for both convenient operation and good visibility, and a "deadman" feature anchors the unit in place when the tramming levers are released.

See the Trac-Newmatics at your Le Roi distributor — or write us for more detailed information. Le Roi Division, Westinghouse Air Brake Co., Milwaukee 1, Wisconsin.

. . . . straight ahead

## LE ROI NEWMATIC® AIR TOOLS

. . . straight down

PORTABLE AND TRACTAIR® COMPRESSORS • STATIONARY COMPRESSORS • AIR TOOLS

. . . or over-the-tracks

AT-015

# HARBISON-WALKER REFRACTORIES

*conventional—specialized and truly unique*
*for dependable performance in every metallurgical operation*

## for COPPER furnaces

### CHROMEX B

The desirable properties which account for the excellent service secured from this extra hard-fired chrome-magnesite refractory are: high density and impermeability — relatively low thermal expansion and good resistance to thermal shock — unusual stability and strength at high temperatures. Among the important applications for this brand in copper furnaces are its use in converter linings, complete walls and bottoms of refining furnaces and in parts of matte smelting furnaces. It is used with excellent results in linings of electric copper melting furnaces.

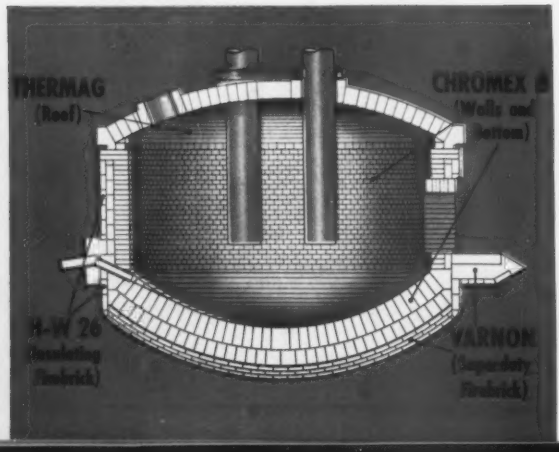
### THERMAG

This hard burned spinel-bonded magnesite-chrome refractory possesses the chemical and physical properties which make it particularly suited for roofs of electric copper melting furnaces.

### H-W PERIKLASE AND H-W MAGNESITE

For the most strongly basic linings, these refractories, consisting predominantly of periclase (stabilized crystalline magnesia), fulfill the most severe requirements. They are fired at an extremely high temperature and are dense, strong and volume-stable at temperatures above the highest employed in copper furnaces. The unusually high magnesia content of these brands, together with their enhanced physical properties, account for the wide preference they continue to gain for use in various metallurgical furnaces.

***Cross-section of Electric Copper Melting Furnace lined with Harbison-Walker Refractories.***




### METALKASE MAGNEX AND METALKASE MAGNEX XXP

Among basic refractories, Harbison-Walker METALKASE MAGNEX brick are most resistant to severe spalling conditions. They are furnished in various sizes and shapes and are made in both chemically-bonded and hard-fired refractories of various compositions which are used with particular benefit in suspended roofs of smelting and refining furnaces.

METALKASE MAGNEX XXP are available in various compositions and are furnished in standard sizes and suspended arch shapes.

### STAR — VEGA AND VEGA HP (hot patch)

STAR brand is widely regarded as standard for refining furnace bottoms and roofs and is used with excellent results in the roofs of some reverberatory matte smelting furnaces.

VEGA is the original superduty high temperature silica brick from which greatest benefit is derived in positions where extremely severe conditions prevail.

VEGA HP (hot patch), with only minor changes in composition and cold strength and not any appreciable decrease in porosity, density and refractoriness, possesses the superior property of spalling resistance.

### CALAMO 200 — ANODE MOLD WASH

This alumina-silica pulverized refractory, most satisfactorily fulfills the requirement of the anode mold wash.

**Other Harbison-Walker Accessories** for pouring molten copper include launder shapes and funnels, furnished in several classes of refractories.

## for ALUMINUM furnaces

Refractories which are best suited for use in aluminum melting and holding furnaces possess properties which meet various specific requirements. In some furnaces the refractories in the bottoms are subjected to severe impact and abrasion. In the production of various alloys to meet certain rigid specifications, the refractories used must be such that any contamination, such as silicon pick-up, is avoided. High resistance to wetting and penetration by molten metal is paramount.

### CORAL P AND CORAL

These 85% alumina brick are produced in complementary compositions and both possess unusual physical properties which commend them for aluminum melting furnace bottoms and lower sidewalls. These brick are

not wetted and penetrated by aluminum and its various alloys and are highly resistant to chemical reaction. They are exceptionally strong and withstand severe impact and abrasion.

CORAL P is phosphate bonded while its counterpart CORAL is hard burned which, together with its special bond (patent pending), account for its unusual combination of desirable properties for use in aluminum melting and alloying furnaces.

### KORUNDAL

This 90% alumina refractory made in several modifications is particularly adapted for various specific needs for bottoms and lower sidewalls.

### H-W SILICON CARBIDE REFRACTORIES

HARBIDE silicon carbide brick possesses some measurably enhanced physical properties of major importance. It is unusually resistant to oxidation and wetting by various molten alloys and can be used to advantage in certain furnace positions.

MULCARB is the mullite bonded silicon carbide product made in various standard and special shapes to serve best for some particular sets of operating conditions.

### ALAMO

Along with other Harbison-Walker superduty fireclay brick brands, ALAMO is favored for upper walls and roofs. Harbison-Walker products for aluminum furnaces comprise additional brands of high-alumina and high-duty fireclay brick possessing the properties needed for best performance.

### BONDING MORTARS

CORALBOND is a unique phosphate bonded 85% alumina mortar developed specifically for use in aluminum melting furnaces. It is exceedingly resistant to penetration, and in the joints between the high-alumina brick it adds tremendously to the strength of the structure.

HARWACO BOND (diaspore base), THERMOLITH (chrome base) and KORUNDAL BONDING MORTAR (stabilized alumina base), air-setting high temperature bonding mortars have unusually high strength for the temperature range of their use. While these may be used interchangeably for laying the various types of brick, each provides special benefits for particular applications.

### H-W MONOLITHIC MATERIALS

KORUNDAL RAMMING MIX . . . H-W HARCHROME CASTABLE . . . H-W EXTRA STRENGTH CASTABLE and H-W PLASTIC FIREBRICK among the full complement of Harbison-Walker monolithic refractories, are especially adapted for aluminum furnace requirements. They are favored in this industry because of the pronounced properties of volume stability, low thermal expansion and high resistance to both penetration and abrasion.

## for other NON-FERROUS furnaces

The service conditions in furnaces employed in the numerous non-ferrous metallurgical processes vary widely and the refractories must meet highly specialized requirements. The selection of the proper refractory frequently governs the degree of success of the processes employed in the reduction, refining and melting of these metals. Harbison-Walker products comprise all the different types and classes of refractories needed for all the metallurgical processes, such as for the reduction and refining of nickel, lead, zinc, tin and other metals.

Extensive research and experience govern the selection of the particular Harbison-Walker refractories which serve best in metal chloride furnaces such as those used for making titanium and zirconium chlorides and for the production of metallic sodium and magnesium. Brands generally favored for these requirements are VARNON BF, H-W MULLITE and DURO.

## some other H-W basic refractories

In the above are cataloged only briefly some of the many Harbison-Walker refractories extensively used in non-ferrous metallurgical operations. Many of these overlap in their large-tonnage usage in the steel industry. Several of particular noteworthy developments are:—

**OXILINE H** and **OXILINE CL** tar-bonded brands, **OXIBAK** hard burned brick and **OXIMIX** monolith—the leading basic refractories for oxygen steel vessels.

**METALKASE MAGNEX OHR XXP** — the unexcelled brick for roofs of the all-basic open hearth steel furnace, used for both sprung and suspended roofs in the oxygen steel practice.

**CHROMEX** — a chemically-bonded chrome-magnesite brick having excellent spalling resistance.

**MAGNEX** — a chemically-bonded magnesite-chrome brick — highly basic and of low spalling tendency.

**H-W CHROME** — a hard-burned chrome brick especially adapted for various specific uses.

**FORSTERITE L** — the only commercially produced magnesium-silicate brick — used in roofs of metallurgical furnaces and in checker settings of open hearth steel furnace regenerators.

**OTHER MONOLITH-FORMING BASIC REFRACTORIES** Ramming Mixtures . . . H-W C-MIX (high purity seawater periclase for contour-rammed basic bottoms) . . . H-W MAGNAMIX (especially suited for patching large holes) . . . H-W MAGNAMIX 85 (especially suited for the construction and maintenance of hearth and lower sidewalls of open hearth and electric steel-melting furnaces) . . . H-W MAGNASET (quick-setting basic grain material which serves best for hot patching and for maintenance of bottoms and banks of furnaces).

The superior performance of Harbison-Walker basic refractories is the result of a thorough knowledge of the requirements, extensive and continuous original research conducted by the Harbison-Walker Research Department, and highest quality raw materials processed in modern plants under close laboratory control.

*Harbison-Walker's Technical Assistance is freely offered for the Selection and Application of Refractories that will serve dependably and economically.*

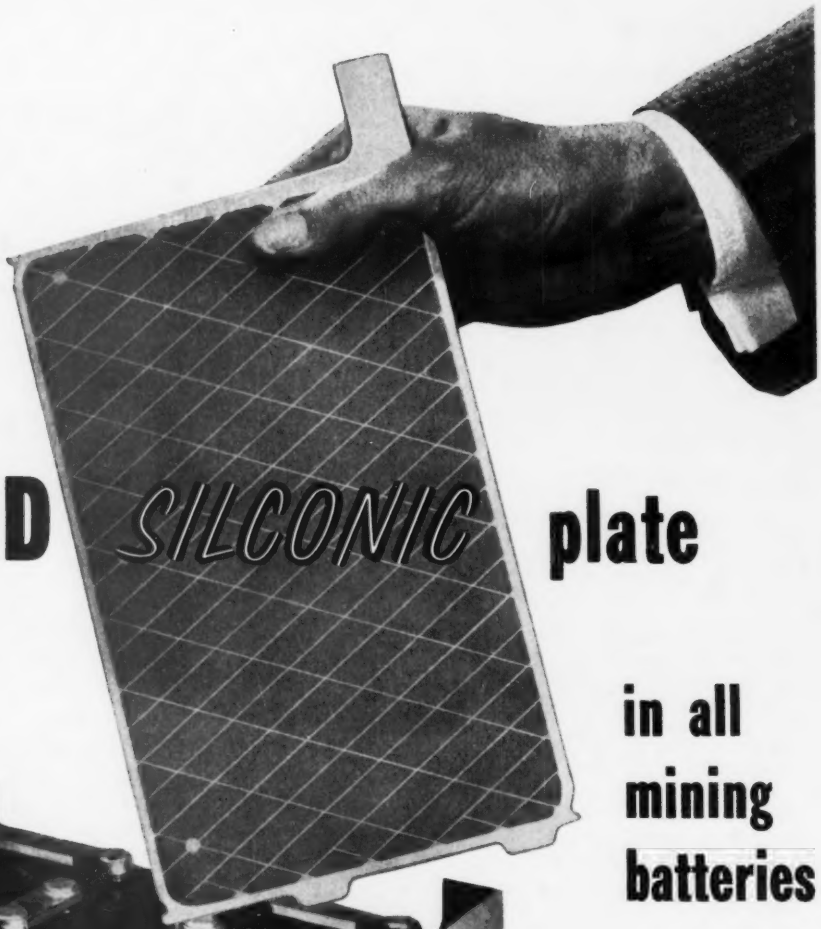
**Harbison-Walker Refractories Company**

AND SUBSIDIARIES

*World's Most Complete Refractories Service*

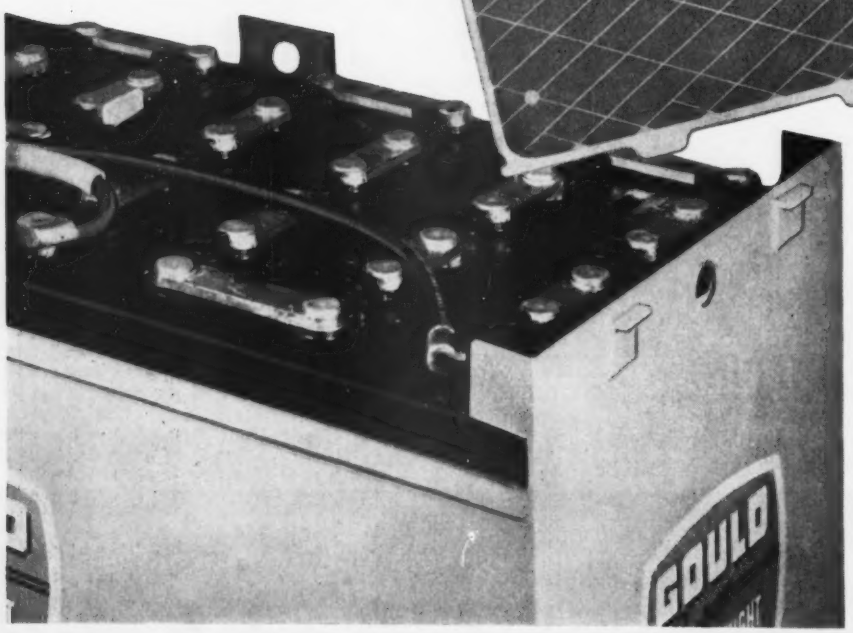
General Offices: Pittsburgh 22, Penna.

# EXTENDS BATTERY LIFE 25%-AT NO EXTRA COST!




## the new GOULD plate

## in all mining batteries



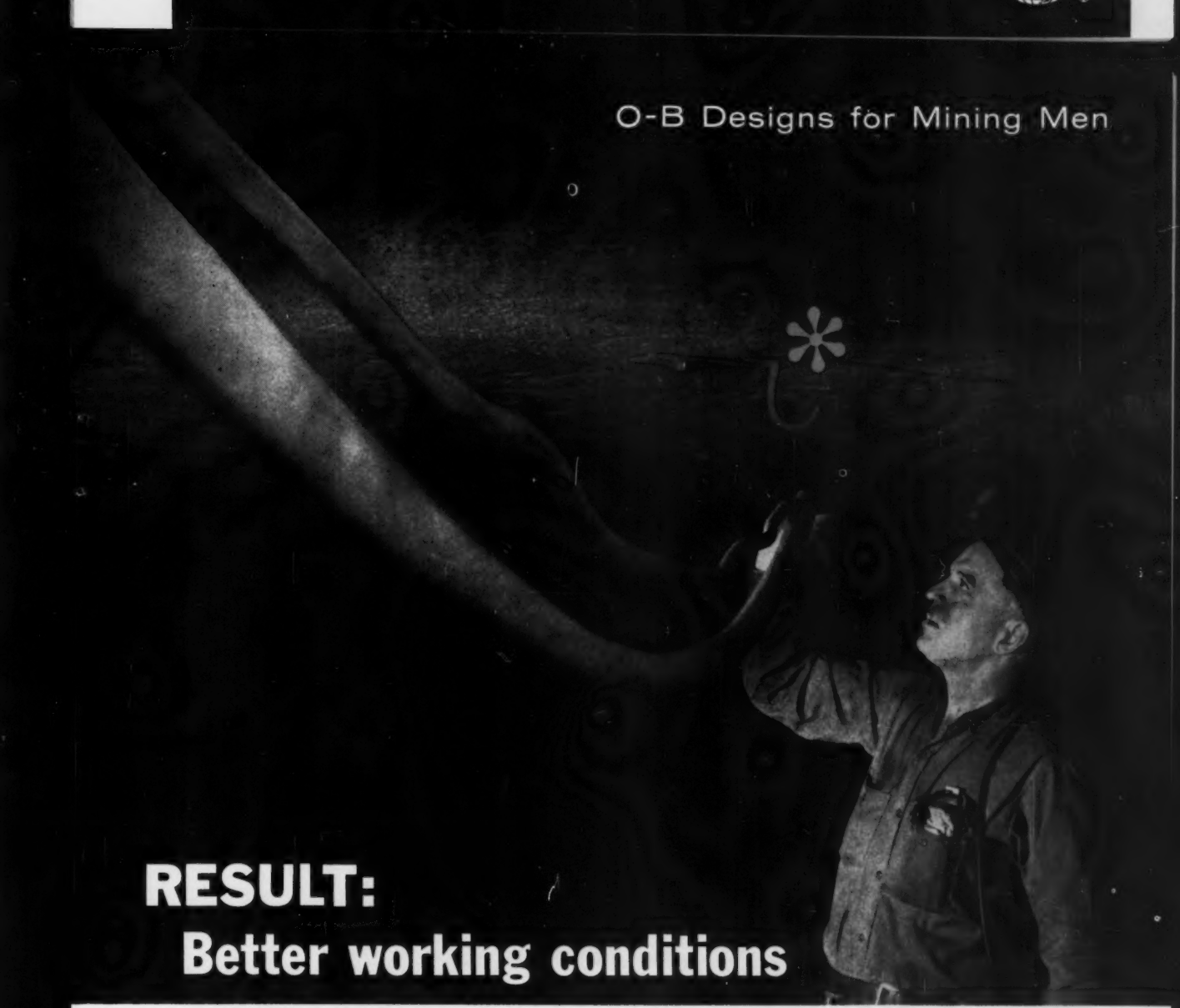

Write for catalog GB-1876
GOULD-NATIONAL BATTERIES, INC.
Trenton 7, New Jersey

In Canada, write to Gould-National Batteries of Canada, Ltd., 1819 Yonge Street, Toronto, Ontario.

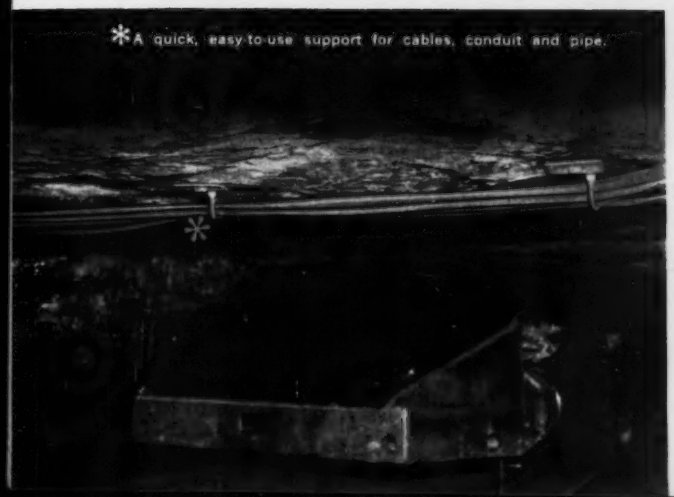
**GOULD**

PATENTED JULY, 1958

O-B Designs for Mining Men



# RESULT:
# Better working conditions for men and equipment



*A quick, easy-to-use support for cables, conduit and pipe.

The O-B roof plate hook installs with one hammer blow.

- CLEARS MINE BOTTOM FAST AND EASY . . . cables, conduits and pipe go out of the way overhead leaving a clear way underneath for men and machines.
- PROTECTS ITS LINES FROM DAMAGE . . . saves costs because cables and other such valuable linage are held out of the way of wheels and feet.
- THESE HANDY HELPERS CAN BE USED OVER AND OVER AGAIN . . . once a section has been worked out . . . roof plate hooks can be reclaimed as easily as they were installed. This easy-to-use support moves with your operation! Order them from your O-B representative when he next stops at your mine. O-B Roof Plate hooks will make your mine operation safer and faster.

OHIO BRASS COMPANY, MANSFIELD, OHIO—Canadian Ohio Brass Company, Ltd., Niagara Falls, Ontario.

Ohio Brass

HOLAN

EXPANSION SHELLS AND PLUGS · LINE MATERIALS · SAFETY AND CONTROL EQUIPMENT · ELECTRIC HAULAGE MATERIALS

10045-M

# Power for Toquepala

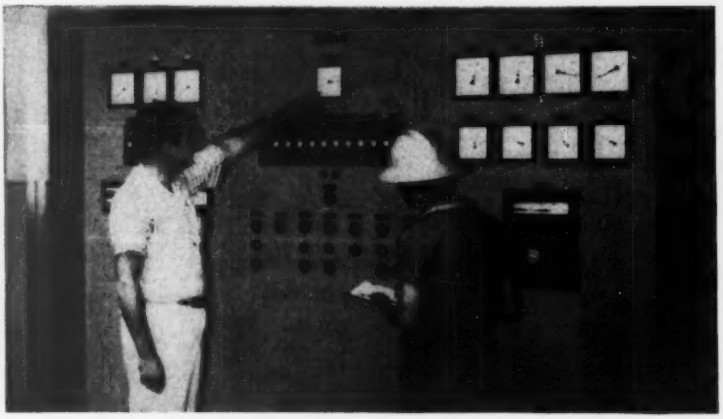
**...an example of global engineering by Brown Boveri**

BROWN BOVERI

*Today American free enterprise is finding opportunities all over the world. And wherever in the world these opportunities are to be found, chances are Brown Boveri is there already with factory-trained specialists, company-owned production and service facilities and the precious advantage of local know-how and engineering experience.*

In planning the gigantic Toquepala project, the combine headed by American Smelting and Refining Company and its consulting engineers, Stearns-Roger Mfg. Company, turned naturally to Brown Boveri for the power supply. In Peru, nearly all large turbo-sets are Brown Boveri-built and our company there is an established service organization with resident engineers available anywhere in the country.

Look where you will the story is the same – be it gas turbines in Arabia, rectifiers in Rhodesia, switchgear in India, a turbo-compressor in Pakistan, power line communications in the Congo or mining operations in Arizona or Toquepala—it's routine for Brown Boveri.

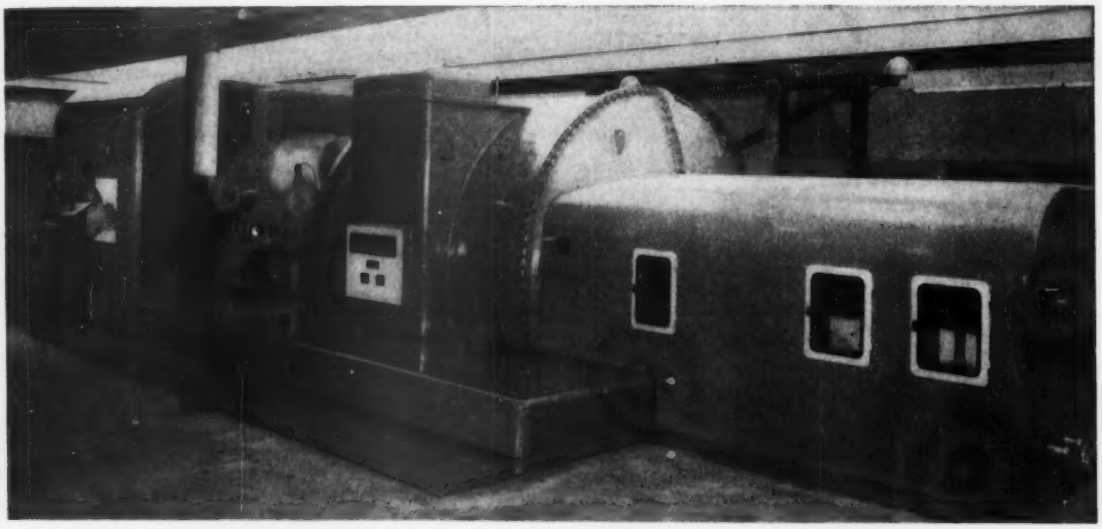


Control panel for one of the Brown Boveri turbine-generators.

Over 80% of the production of Brown Boveri's great Swiss works is exported and we maintain production facilities, sales and engineering offices in over 65 countries with close to 70,000 people on our payroll.

If you are thinking of an overseas project of any kind, we invite you to draw on this unique experience in global engineering. We think you'll be glad you did.

*Brown Boveri builds steam and gas turbines, boilers, condensers, generators, transformers, switchgear, rectifiers, motors and complete rolling mill drives, compressors, electric furnaces, betatrons, induction heating equipment, communication equipment.*



One of two Brown Boveri 20/22 MW Preferred Standard steam turbine-generators at Toquepala copper smelter in the Peruvian Andes. Generators are 60 cycle, 3600 rpm.

They power huge electric stripping shovels, smelter blowers, crushers, separators and other heavy mill equipment . . . and two company housing projects.

This is the biggest thermal station in Peru. Brown Boveri also supplied the two main condensers, the dump condenser and the air ejectors.

**BROWN BOVERI** Brown Boveri Corp., Dept. EM6, 19 Rector Street, New York 6, N. Y. Agents in 27 U. S. cities.

SERIES 9000
For continuous service, heaviest and coarsest materials.
SERIES 8000
For continuous operation, heavier-weight, abrasive materials.
SERIES 7000
For continuous operation, heavyweight, abrasive materials.
SERIES 6000
For intermittent operation or continuous handling of lightweight material.
SERIES 5000
For intermittent or light service, fine or small lump materials.

**5** series of belt conveyor idlers

# end wasteful over and under-engineering

**LINK-BELT's complete line is your best insurance against high replacement and maintenance costs**

Now, industry's broadest belt conveyor idler line becomes even broader! This permits even greater "pin-point" selection, resulting in substantial savings in purchasing and maintenance by avoiding wasteful over or under-engineering. Five series in 850 types range in application from light or intermittent service to continuous heavy-duty operation —from 20° up to 45° troughing for a broad range of belt widths—with rolls of various diameters, materials and coatings.

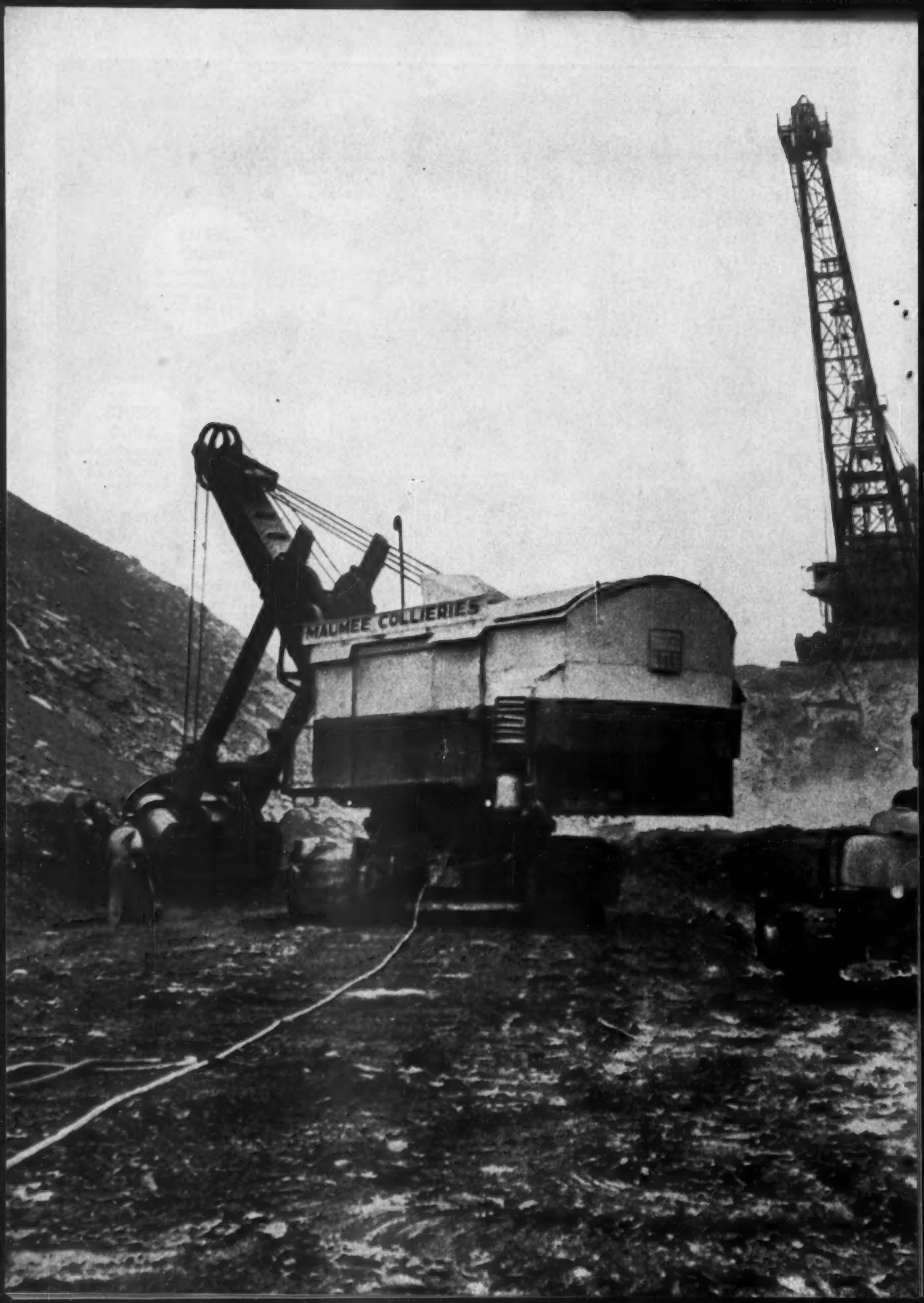
15,915

For further facts on this broad line—contact your Link-Belt office or authorized stock-carrying distributor. Look under CONVEYORS in the yellow pages of your phone book. Or write for new Catalog 2716.

**LINK-BELT**

**BELT CONVEYOR IDLERS**

LINK-BELT COMPANY: Executive Offices, Prudential Plaza, Chicago 1. To Serve Industry There Are Link-Belt Plants, Warehouses, District Sales Offices and Stock Carrying Distributors in All Principal Cities. Export Office, New York 7; Australia, Marrickville (Sydney); Brazil, Sao Paulo; Canada, Scarboro (Toronto 13); South Africa, Springs. Representatives Throughout the World.


MAUMEE COLLIERIES

At the Maumee Collieries in Indiana...

# ANACONDA SHOVEL CABLE HAS A RECORD: 10 YEARS ON THE ROCK PILE!

## Anaconda's SH-D Cable gives many years of dependable service in spite of heat, moisture, kinks, rocks and runovers!

How many shovel cable hazards can you count in this picture from the Maumee Collieries? Rocks . . . moisture . . . kinks . . . danger of runovers—they're all there. Yet the first installation of Anaconda's rugged SH-D Shovel Cable has resisted them all—*for 10 long years!*

It's proof again of the way Anaconda's in-the-field experience with Shovel Cable pays off in a superior cable for you. The important knowledge gained from use and testing of SH-D Cable *on the job* in our own mines goes into the design and manufacture of Anaconda Shovel Cable.

For example, the insulation is Anaconda Butyl (AB). Nothing can beat it for withstanding ozone, heat and moisture. Patented rubber cores cushion the ground wires and help prevent breaks from kinks and runovers. SH-D has a neoprene jacket that is exceptionally tough and abrasion-resistant. And every design, every component has been job-tested—your assurance of superior quality and performance.

Call on the Man from Anaconda with your cable problems. Or see your local Anaconda distributor. For new descriptive Bulletin DM-5818, "Anaconda Securityflex Portable Cables for the Mining Industry," write: Anaconda Wire & Cable Co., 25 Broadway, New York 4, New York.

For a decade, the Anaconda SH-D Shovel Cable you see here has been giving dependable service for the Maumee Collieries, Jasonville, Indiana. Its many superior design features enable it to resist on-the-job hazards that would knock out ordinary shovel cables.

ASK THE MAN FROM

# ANACONDA®

FOR **SHOVEL CABLE**

# EXPLORING OR MAPPING...

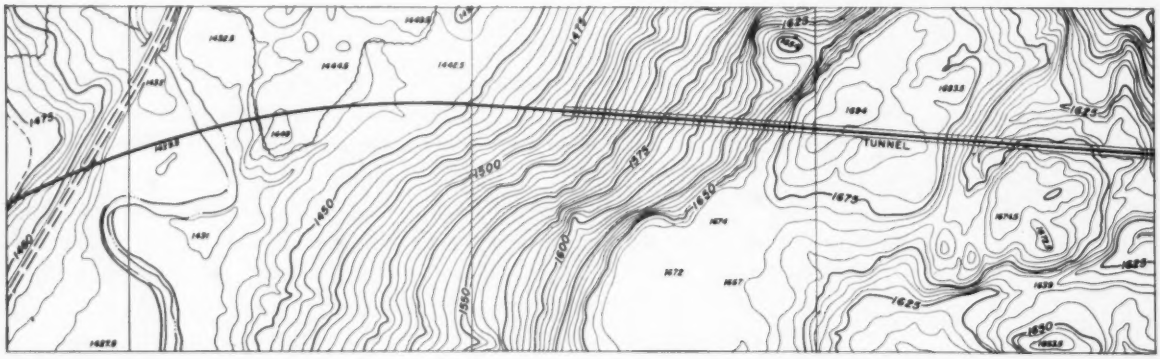
## *AERO SERVICE SPEEDS THE JOB!*

***FOR EXAMPLE:*** *A search for sulphides in New England*

**PROBLEM:** Exploration for sulphide ores in brush-covered, hilly New England area.

**SOLUTION:** Helicopter-borne magnetometer and electromagnetic detector survey by Aero Service Corp. Survey was flown at tree-top level, gave maximum detailing.

**SAVING:** Comparison of magnetic record and of in-phase and out-of-phase EM signals permitted full and rapid evaluation of magnetic and electromagnetic anomalies, saving ground work. The correlated air survey information pin-pointed the ground targets to be studied in greater detail.




***FOR EXAMPLE:*** *Location of a mine railroad in Minnesota*

**PROBLEM:** Location of a 75-mile railroad over swamp and brush-covered area from Hoyt Lakes, Minnesota, to Lake Superior port.

**SOLUTION:** Aerial photographing, mapping, and photo interpreting by Aero Service Corp. Final location of railroad was made with five-foot contour-interval map, shown above, with a horizontal scale of 1 inch: 200 feet.

**SAVING:** Complete surveying, mapping, and location work was finished in 1½ years, with construction contracts for the railroad executed and in active progress less than two years after the first planning.

---

**Whatever your mapping or airborne geophysical exploration need —anywhere in the world—Aero can speed your project. Our services include photo and topo maps, airborne magnetic and electromagnetic surveys. Write for Aero's report on how to cut costs and save time. We shall be glad to meet with your staff, to discuss specific projects.**

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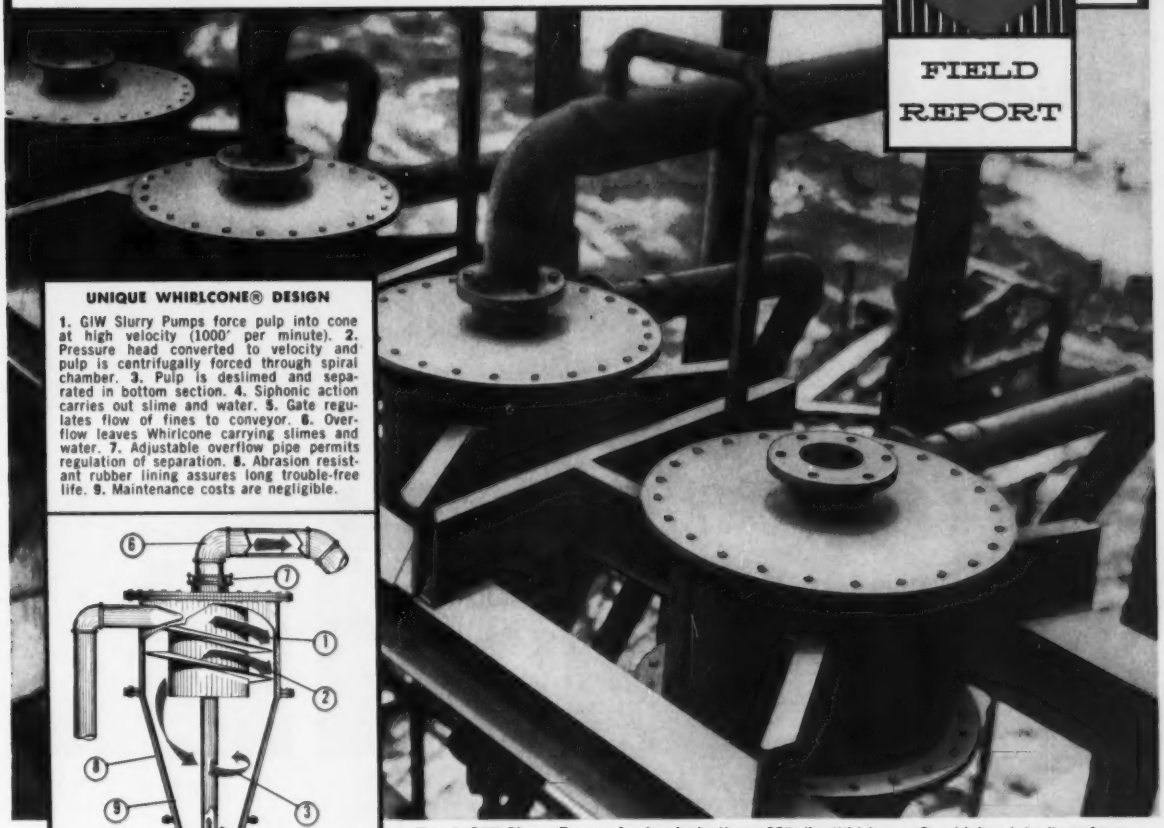
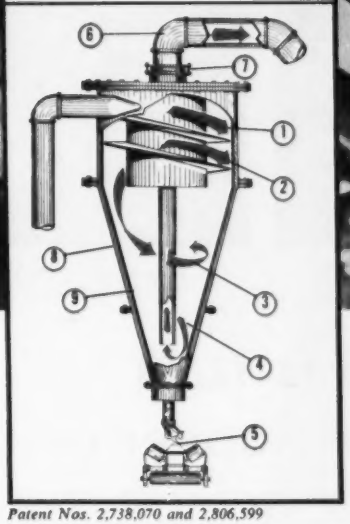
GIW

FIELD REPORT



**UNIQUE WHIRLCONE® DESIGN**

1. GIW Slurry Pumps force pulp into cone at high velocity (1000' per minute). 2. Pressure head converted to velocity and pulp is centrifugally forced through spiral chamber. 3. Pulp is deslimed and separated in bottom section. 4. Siphonic action carries out slime and water. 5. Gate regulates flow of fines to conveyor. 6. Overflow leaves Whirlcone carrying slimes and water. 7. Adjustable overflow pipe permits regulation of separation. 8. Abrasion resistant rubber lining assures long trouble-free life. 9. Maintenance costs are negligible.




*Patent Nos. 2,738,070 and 2,806,599*

Tough GIW Slurry Pumps feed pulp to these 25" dia. Whirlcones®, which retain fines from classifier overflow. Maximum recovery rate is 20 tons per hour per cyclone. The cones will handle material from −12 mesh to lightest slime.

# Whirlcone® Separators solve difficult fine recovery problems.

The retention of fines in the −50 plus 200 mesh range posed a disturbing problem for the Becker County Sand & Gravel Co., of Cheraw, S.C., primarily because the large amount of water used in processing the sand and gravel washed out the desirable fines with the minus 200 slimes.

Fourteen 25" dia. Whirlcone® wet type cyclones installed parallel in four Becker plants solved this problem completely. Operating an average of 8 hours daily, they extract up to 100 tons of clean, fine sand per hour from wash water while the minus 200 mesh slime is discarded.

Recovered fines are used to bring sand up to specifications. Thousands of tons of valuable sand, formerly lost, soon paid for the low cost of the Whirlcones®.

GIW's highly efficient Whirlcones® are also being used in the mining fields to deslime, degrit, classify, concentrate, make dam and mine backfill and to dewater or thicken where the overflow can be returned to the process or it can be discarded.

They are available in diameters from 6" to 50". Capital cost including the pump is 20 to 50% of conventional classifiers.

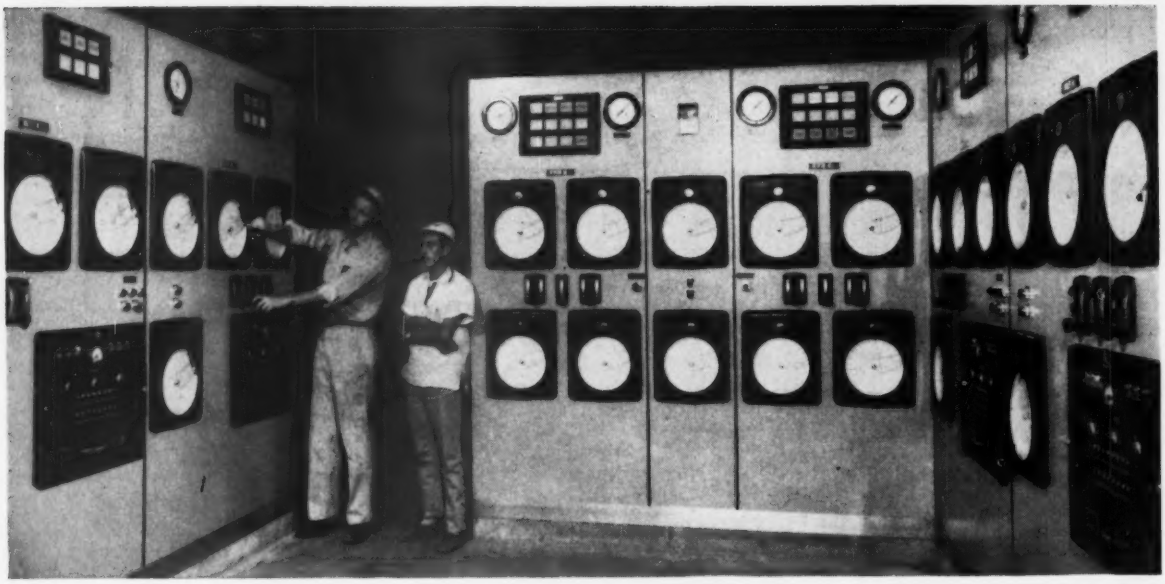
If you are losing fines from material −12 mesh to lightest slimes, write today. Recommendations and literature will be forwarded promptly.

COTTRELL ENGINEERING
Division of
GEORGIA IRON WORKS CO.

GIW

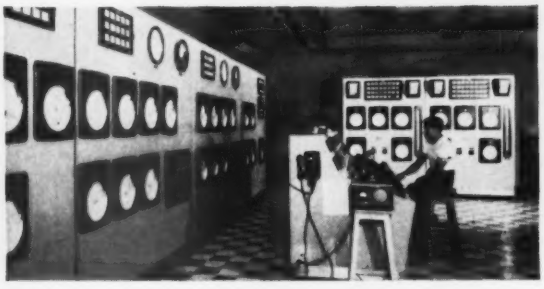
*Manufacturers of pumps, dredges, separators and accessories.*

AUGUSTA • GEORGIA

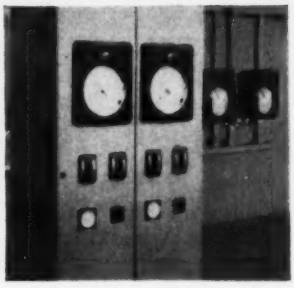


Controls for waste-heat boilers and reverberatory furnaces.

Lime kiln control panel.



Controls for combustion, feed water, and steam temperatures of power boilers.



Turbo-blower control and air flow meters.

# At TOQUEPALA and ILO

## . . . world's most instrumented copper plant

Every major process and power component at the Southern Peru Copper Corporation installation is overseen by a system of highly engineered instruments . . . sensing, indicating, recording, and controlling. This is one of the most complete networks found at any primary copper producing plant.

Prominent in development of this instrumentation has been the Bailey Meter Company. Some of the Bailey equipment is shown above. Other units include: gas analysis cubicles, converter controls, lime slaker controls, centrifugal blower controls, anti-reverse flow controls, differential level controls, and feed water, temperature, and level transmitters.

Bailey was a logical selection. For more than 40 years, they've lead the development of instruments and controls. And, as marked by Toquepala and Ilo, their scope is dramatically comprehensive.

Whatever your process-instrumentation need, Bailey is in a position to help. Check our capability. A Bailey District Office or Resident Engineer is in your vicinity. Refer to your phone book, or write direct. C116-1

*Instruments and controls for power and process*

**NONFERROUS METALS DIVISION**

**BAILEY METER COMPANY**

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BAILEY METERS

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NEW CONSTRUCTION,
EXPANSION OR ALTERATION? . . .

# TALK TO TREADWELL

Take advantage of Treadwell's broad experience and ability in engineering and designing complete plants, plant expansions, plant alterations, machinery and equipment. Many of the nation's leading industries have been using these services with repeated satisfaction. Why don't you talk to Treadwell — soon!

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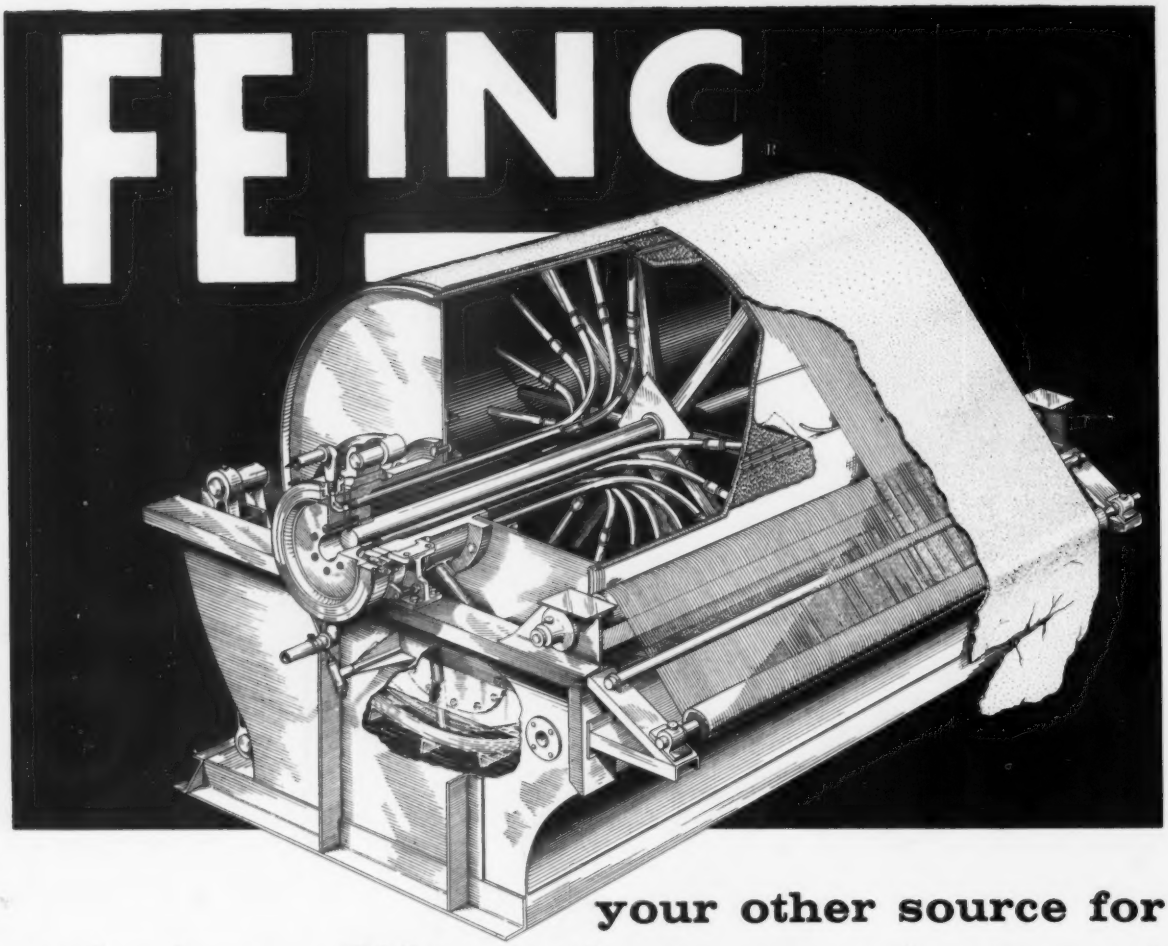
ENGINEERING AND DESIGN SERVICES

COMPLETE ENGINEERING AND DESIGN SERVICES FOR

■ ORE DRESSING ■ MINERALS BENEFICIATION ■ ELECTROLYTIC PLANTS ■ BULK MATERIALS HANDLING ■ SMELTING & REFINING ■ NON-FERROUS FABRICATING PLANTS ■ COMPLETE INDUSTRIAL INSTALLATIONS

MANUFACTURERS OF HOT METAL CARS, CINDER AND SLAG CARS, LADLE TRANSFER CARS, SMELTING & REFINING EQUIPMENT

# FEINC



## your other source for
# mining filtration equipment

### HERE IS WHY FEINC MERITS YOUR CONSIDERATION

FEINC *originated* and *developed* the string discharge filter.

The drum on a FEINC Filter turns on a *heavy, solid steel* center shaft *not found* on most filters. This feature alone can protect against costly drain line breaks and weld cracks. FEINC means *ruggedness.*

With over 35 years total experience, FILTRATION ENGINEERS has been a member of American Machine and Metals, Inc., internationally recognized family of LIQUID-SOLIDS SEPARATION SPECIALISTS for 3 years. This family includes TOLHURST® Centrifugals, NIAGARA® Pressure Filters and FEON® Filter Fabrics. FEINC users benefit from this concentration of filtration experience from many fields.

**SEND US YOUR INQUIRY.** Tell us your problem or tell us your requirements. We offer both complimentary laboratory test and pilot plant rental services. Compare our recommendations and quotations on vacuum or pressure rotary drum (scraper, string or roller discharge), horizontal table or precoat filters. (Disc type filter available *soon.*) Next time, before you decide . . . *investigate* FEINC. Write for Bulletin 103.

## FILTRATION ENGINEERS
A DIVISION OF
American Machine and Metals, Inc.
EAST MOLINE, ILLINOIS

FEON®

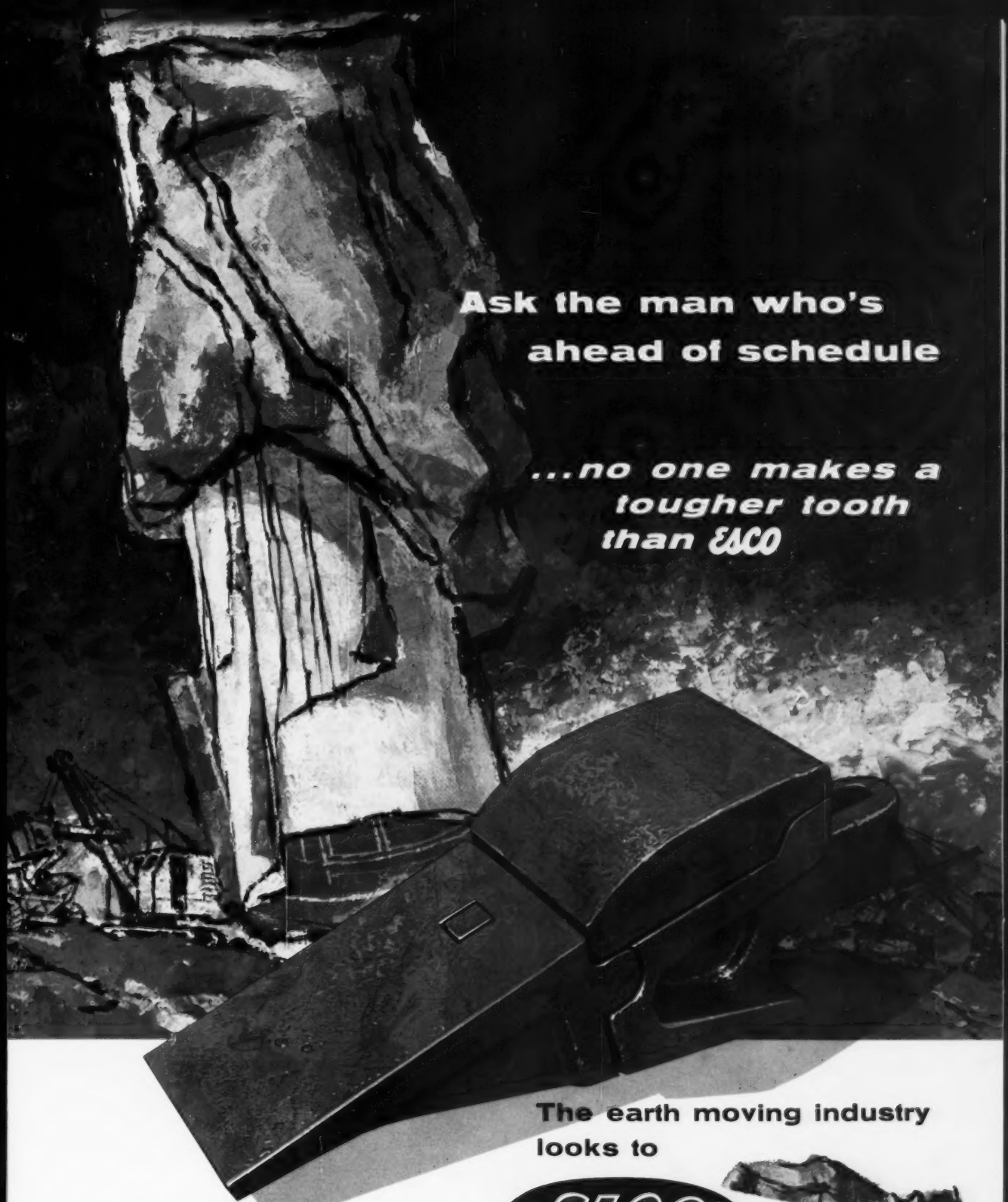
### FILTER FABRICS ARE TAILORED FOR THE JOB

Filter fabric construction details are not enough. Correct design and fit affect filter media life and performance. FEON manufactures correctly designed and fitted . . .

ANODE BAGS AND DIAPHRAGMS
CENTRIFUGAL LINERS
DUST TUBES
PLATE AND FRAME FILTER COVERS
PRESSURE LEAF DISCS
PRESSURE LEAF SACKS
VACUUM DISC SECTOR BAGS
VACUUM DRUM COVERS, BELTS, BLANKETS
YARDAGE PRODUCED OR SLIT TO WIDTH

Send your inquiry to
FILTRATION FABRICS

*Divisions of American Machine and Metals, Inc., New York 7, New York* • TROY LAUNDRY MACHINERY • RIEHLE TESTING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • RAHM INSTRUMENTS • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION




The right design, the right steel, the right shape make *ESCO* Two Piece Teeth right for every digging condition.

**The earth moving industry looks to**

ESCO®

**Electric Steel Foundry Co.,** PORTLAND, OREGON

*See reverse for shapes and size range*

ING MACHINES • DE BOTHEZAT FANS • TOLHURST CENTRIFUGALS • FILTRATION ENGINEERS • FILTRATION FABRICS • NIAGARA FILTERS • UNITED STATES GAUGE • RAHM INSTRUMENTS • LAMB ELECTRIC COMPANY • HUNTER SPRING COMPANY • GLASER-STEERS CORPORATION

# Here are the points to remember...

Each easy-to-change *ESCO* Point is Brinell tested to assure exactly the right degree of shock-absorbing toughness and abrasion-resisting hardness for longer life.

## 12M ALLOY STEEL

*ESCO* 12M Two Piece Teeth are the toughest you can use. Developed through years of research for the earth moving industry, cast *ESCO* 12M is the finest steel made for severe shock and abrasion.

## ESCO TWO PIECE TEETH

### for all your digging equipment

Your *ESCO* dealer can supply two piece teeth for all your equipment. Consult him about standardizing on *ESCO* teeth for the added advantages of quality purchasing and reduction of on-the-job inventories.

**8 POINT TYPES**
**FOR EVERY DIGGING CONDITION**

## WEAR CAP ADAPTERS

The ESCO Wear Cap Adapter, winner of the Blue Ribbon Mining Award, is the most rugged tooth assembly ever developed for handling tough rock and taconite. Replaceable wear caps sharply increase service life by protecting the adapter from wear. No special pins or welding required.

GENERAL PURPOSE | ROCK | ROCK PICK | PICK | SHARP FLARED | SHARP | SHARP LONG | RIPPER

**Electric Steel Foundry Company**
2179 N.W. 25TH AVE. • PORTLAND 10, OREGON

MFG. PLANTS AT PORTLAND, ORE. AND DANVILLE, ILL.
Offices in Most Principal Cities
ESCO INTERNATIONAL, NEW YORK, N. Y. • IN CANADA ESCO LIMITED

ESCO®

LITHO IN U.S.A.

See reverse for shapes and size range

## NOW! A SCREEN WITH A

# rubber bumper

HENDRICK RUBBER CLAD PERFORATED METAL is now available with a specially designed rubber covering. Ideal where extreme abrasion is a problem, rubber clad Hendrick Perforated Screens assure far less plate wear. Large chunks of ore, coal or stone hit the screen with a fully cushioned shock . . . the rubber coating also takes the brunt of wear by protecting the steel plate underneath. The rubber laminate is bonded to steel by a new adhesive and vulcanized under controlled heat.

For more details contact your local Hendrick representative or mail in the coupon direct.

**HENDRICK Manufacturing Company**
**Carbondale, Pennsylvania**

PERFORATED METAL SCREENS • WEDGE WIRE SCREENS • CASCADE WEDGE WIRE SCREENS
WEDGE SLOT SCREENS • RUBBER CLAD PERFORATED SCREENS • FLANGED LIP SCREENS
FLIGHTS • SHAKER AND CONVEYOR TROUGHS.

**HENDRICK Manufacturing Company**
70 Dundaff Street, Carbondale, Penna.

Gentlemen: I would like to learn more about Hendrick Rubber Clad Perforated Metal Screens.

☐ Please have representative call.
☐ Please send FREE literature.

NAME_____ TITLE_____

COMPANY_____

STREET_____

CITY_____ STATE_____

# NO GUESSWORK... QUALITY IS CERTIFIED!

*With Republic Mine Roof Bolts steel chemistry, yield point, and break point are known quantities*

Republic takes the guesswork out of mine roof bolt buying. You get certified performance. Performance you can depend on every time, because every step of Republic Mine Roof Bolt manufacture—from raw ore to finished bolt—is carefully controlled, precision checked, and inspected. Every Republic bolt shipment includes a certificate stating specific physical properties of the steel used.

Five certified-performance features—you get them only from Republic—add up to an extra margin of mine safety. Economy? Mining companies report Republic Bolts are making profitable operations possible in areas where the high cost of shoring could force mine shutdowns.

Because mine roof bolts can be used effectively in many different types of strata, no single design is best for all applications. Republic's Field Service Team has worked with mine operators in every part of the country to develop bolts to best meet specific requirements. This obligation-free service is available to you. Write or send coupon today.

**1 PRECISION-TAPERED PLUG**

Engineered for proper shell expansion. Precise degree of taper required for strength, dependability, efficient tightening.

**2 HIGH-STRENGTH, ALL-PURPOSE EXPANSION SHELL**

Wide, strong leaves mean extra holding power. Narrow base supports for easy expansion, wedge-like grip.

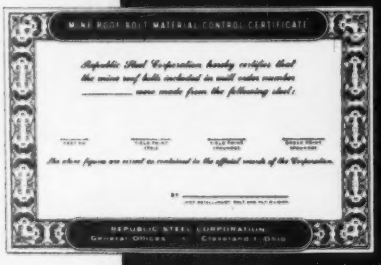
**3 HEAVY-DUTY SUPPORT NUT**

Provides better support for shell than previous methods. By stripping without damage to bolt threads at 50 pounds torque, proper tension in the installed mine bolt is assured.

**4 IMPROVED SELF-CENTERING HEAD** Compact, one-piece head. No separate washer needed. Forged for ruggedness and strength.

**5 MATERIAL CONTROL CERTIFICATE**

Included with every shipment. States specific physical properties of the steel used: yield point, break point, and steel heat number.


MINE ROOF BOLT MATERIAL CONTROL CERTIFICATE

*Republic Steel Corporation hereby certifies that the mine roof bolts contained in said order number _____ were made from the following steel:*

*The above figures are correct as contained in the official records of the Corporation.*

REPUBLIC STEEL CORPORATION
General Offices — Cleveland 1, Ohio

REPUBLIC STEEL

**REPUBLIC STEEL**

*World's Widest Range of Standard Steels and Steel Products*

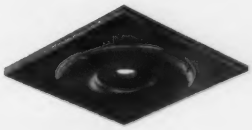
**CORROSIVE ELEMENTS,**
and moisture, found around mining operations, are tough on standard conduit. Answer: *Republic* ELECTRUNITE® *"Dekoron®-Coated" E.M.T.*, made from highest-quality flat rolled open hearth steel, armor-coated from end to end with corrosion-proof polyethylene. Easy to cut to length and bend to fit installation. ELECTRUNITE "Dekoron-Coated" E.M.T. costs less to install, less to maintain. Plastic coated rigid steel conduit also available. Mail coupon for more information.

**ABRASION-RESISTING PERFORMANCE**
of *Republic High Strength Steel* makes it ideal for use in coal and ore discharge chutes, hopper and mine cars. Equipment built with Republic High Strength Steel withstands continual pounding and abrasion, is more corrosion-resistant and weighs less than similar equipment constructed of plain carbon steel. Send coupon for additional information.

**MINE WATER PROBLEMS?**
Solve them the easy, low-cost way—with *Republic Flexible Plastic Pipe*. Made of tough polyethylene, it is impervious to corrosive elements found in mine water. Lightweight Republic FE® Plastic Pipe is easy to handle, easy to cut and join. Can be quickly relocated to meet changing conditions. Mail coupon for further information about Republic Plastic Pipe.

**AVAILABLE PRE-ASSEMBLED**
**TO CUT YOUR INSTALLATION COSTS**

You can order your Republic Certified-Performance Roof Bolts fully assembled to save you assembly costs, prevent loss of parts and damage to bolt threads. Specify Republic Roof Bolt Plates, too.



**REPUBLIC STEEL CORPORATION**
**DEPT. EJ -9670**
**1441 REPUBLIC BUILDING • CLEVELAND 1, OHIO**

Please send me further information on:
- ☐ Republic Mine Roof Bolt Field Service
- ☐ Mine Roof Bolts
- ☐ High Strength Steel
- ☐ Plastic Pipe
- ☐ ELECTRUNITE "Dekoron-Coated" E.M.T.

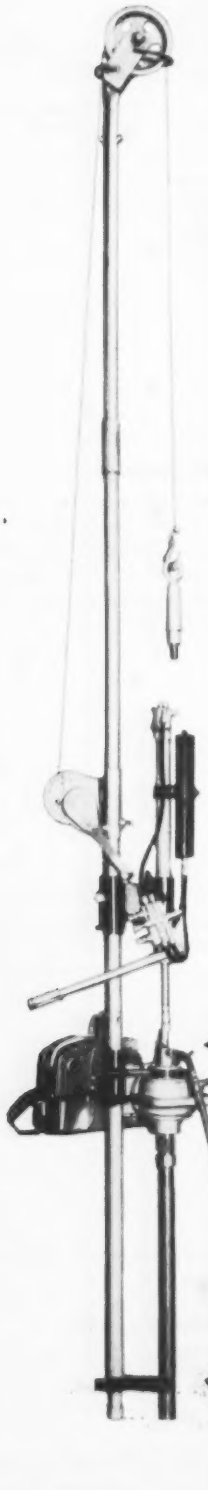
Name_____ Title_____
Company_____
Address_____
City_____ Zone____ State_____

# THE ALL-NEW SUPER PIONEER MARK IX

## PORTABLE DIAMOND CORE DRILL

### GIVES YOU

# POWER TO SPARE!



This high-powered big brother of the famous Super Pioneer is writing new drilling records wherever used. Power, capacity, and performance have all been doubled without sacrificing portability or ease of operation. Total weight of 170 lbs. includes drill, anchor column, hydraulic feed, mast, winch, and pump and hoses. Increased power and optional gear ratios now make it adaptable to all types of mining, engineering, or construction uses. Rugged, lightweight, and built to take it, the Mark IX will set up or tear down in minutes, will drill at any angle including up-holes, and will deliver true core samples in a wider range of sizes than ever before in depths of up to 250' in the hardest of rock formations.

### 12 Feet of Unbroken Core From 200 Feet in Depth!

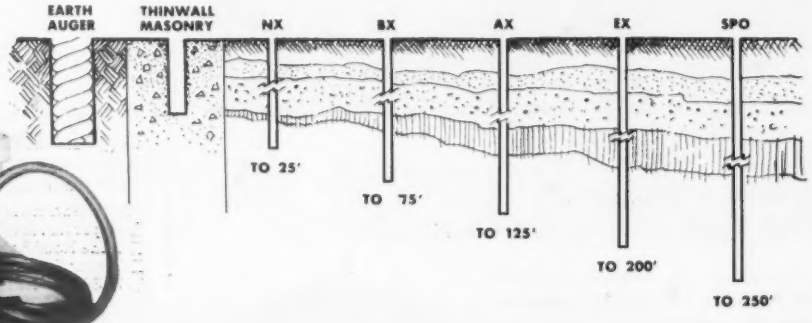
Thousands of feet of test holes in all types formations were drilled in developing and perfecting the Mark IX. All of the "know how" and dependability of over 60 years in the drilling industry are incorporated in this "package of power". Why not put it to work for you!

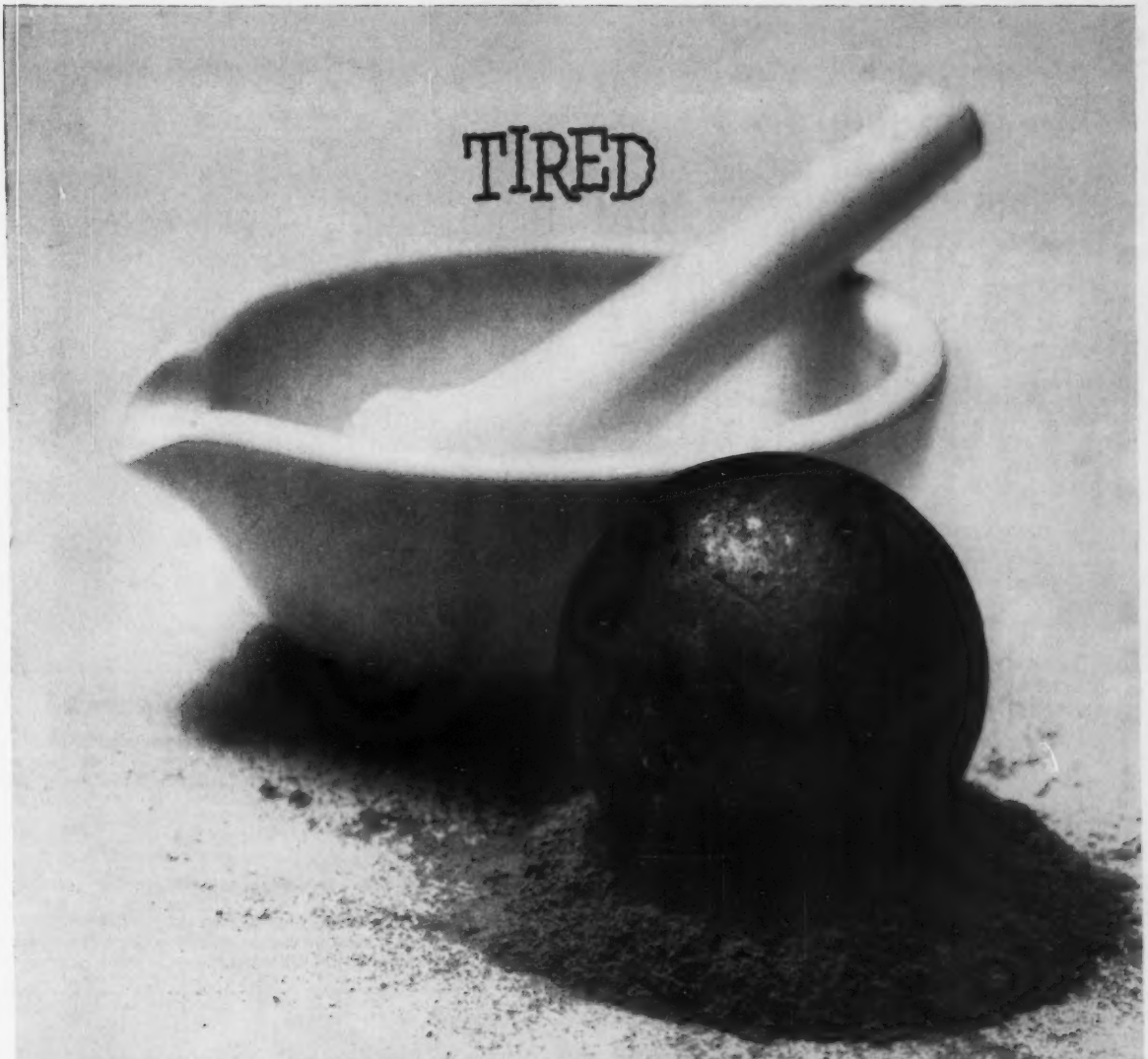
DIAMOND DRILL CONTRACTING COMPANY

South 18 Stone Street — Spokane, Washington, U.S.A.

Export Representatives
SPRAGUE & HENWOOD INTERNATIONAL
11 West 42nd St., New York, N.Y.

Canadian Representatives
T. CONNORS DIAMOND DRILL LTD.
Box 183, Nelson, British Columbia






**TIRED OF THE SAME OLD GRIND?**

Do a better job with added efficiency and economy with Coates Triple-Forged Carbex Grinding Balls. Production run tests show that job for job and dollar for dollar, Coates out-performs grinding balls costing many times more.

Coates Grinding Balls grind better, last longer and wear more evenly because they are carefully made of special formula fine-grained, high-carbon steel, checked and calibrated to be more perfectly round . . . scientifically heat treated to the very core, to be tough and rugged.

Call for Coates Triple-Forged Grinding Balls . . . built with care for longer wear.

Write for prices . . . All sizes—½″ to 5″ carried in stock for immediate shipment.

C855-1

COATES STEEL PRODUCTS CO. CARBEX TRIPLE-FORGED BALLS

COATES

STEEL PRODUCTS COMPANY

GREENVILLE, ILLINOIS

LARGEST EXCLUSIVE MANUFACTURER OF GRINDING MEDIA

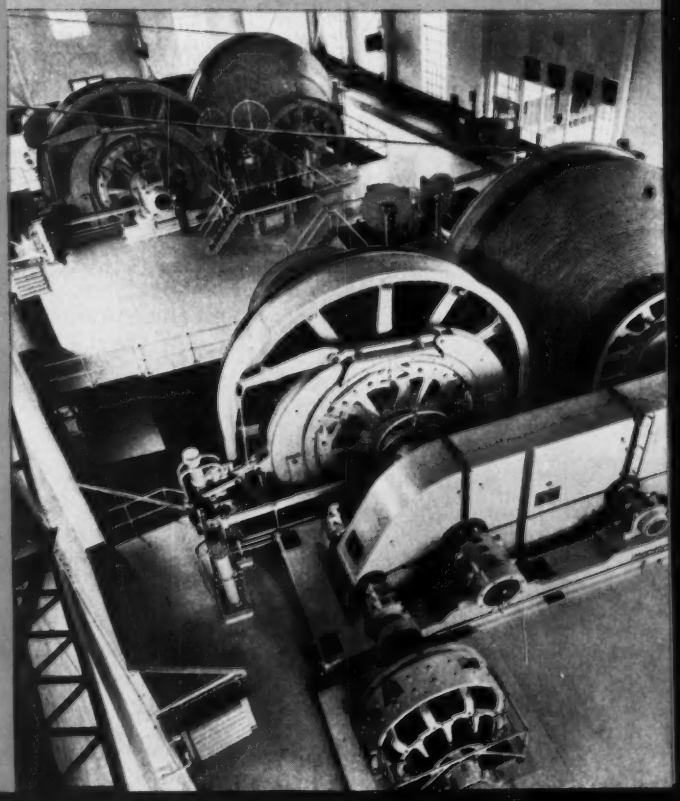
# HOW NORDBERG MACHINERY SERVES THE MINING INDUSTRY

### IN POWER GENERATION

Nordberg engines are built in sizes ranging from small power units to over 12,000 horsepower in a single engine . . . and are available for Diesel, Duafuel® and Spark-ignition Gas operation.

### IN HOISTING

Nordberg has an established reputation second to none, and can furnish both conventional and friction type mine hoists for men and material, to meet specific requirements.



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**Milwaukee 1, Wisconsin**

*SYMONS . . . A Registered Nordberg Trademark Known Throughout the World.*

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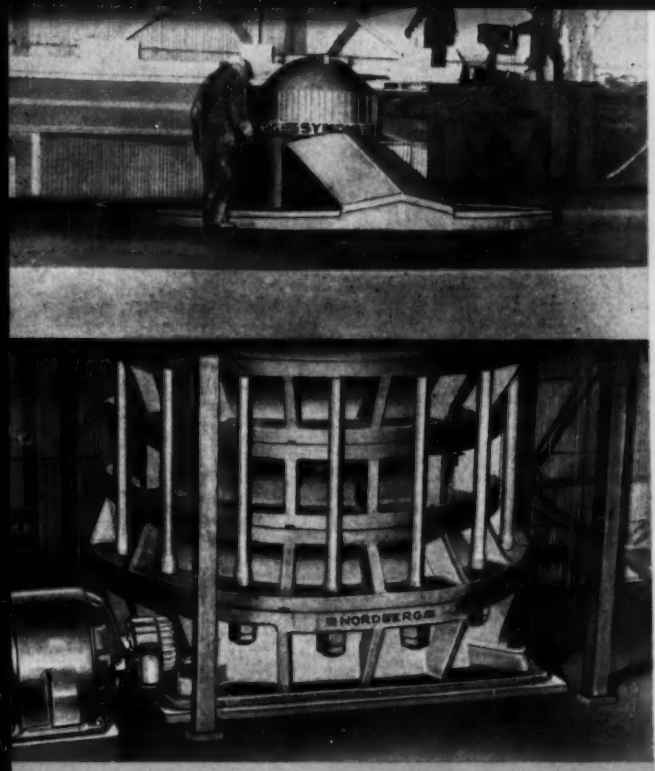
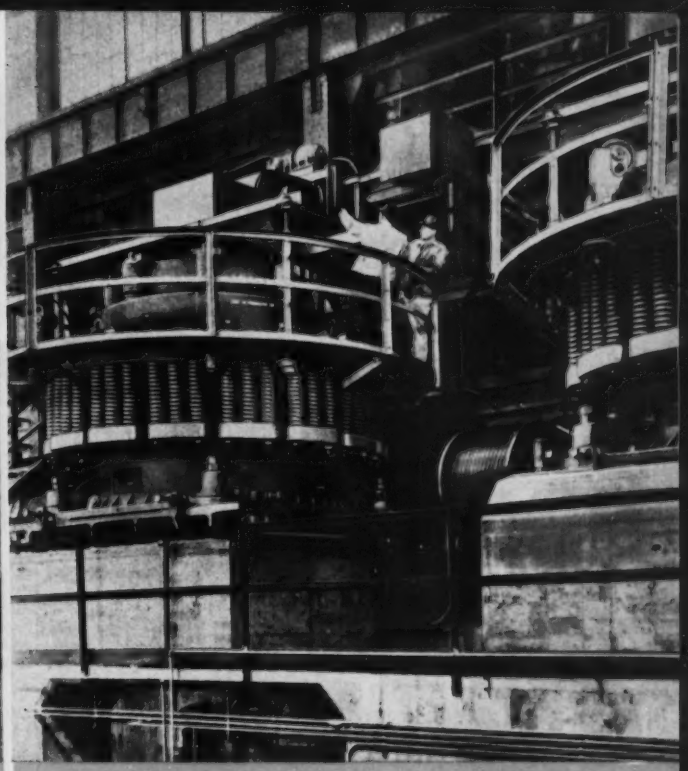
M160-R




## IN PRIMARY CRUSHING

Symons® Primary Gyratory Crushers are built for big tonnage, heavy duty primary breaking in 30", 42", 48", 54", 60" and 72" feed opening sizes. Capacities to 3500 or more tons per hour.

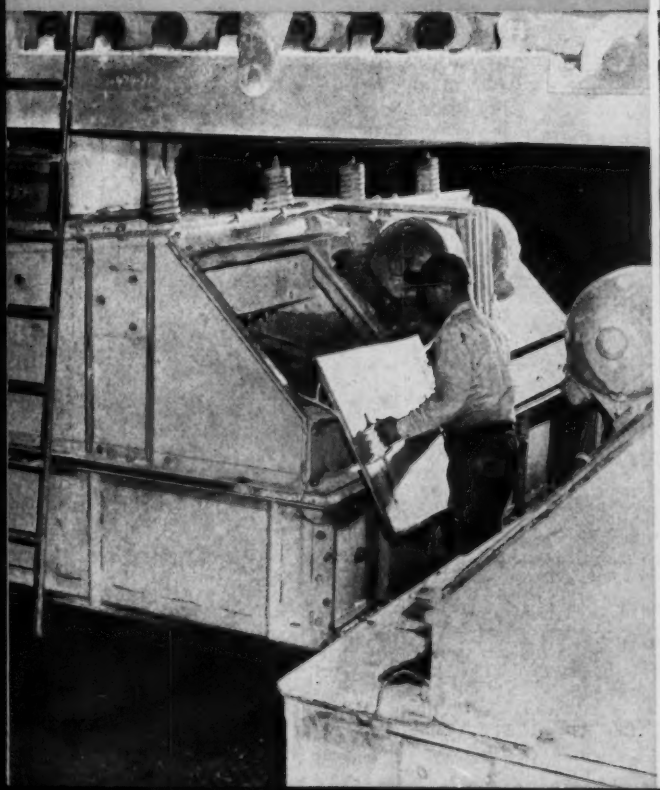


## IN FINE REDUCTION CRUSHING

Symons Cone Crushers, the machines that revolutionized crushing practice, are built in both Standard and Short Head types, in sizes from 22" to 7' in diameter. Capacities from 6 to 900 or more tons per hour.

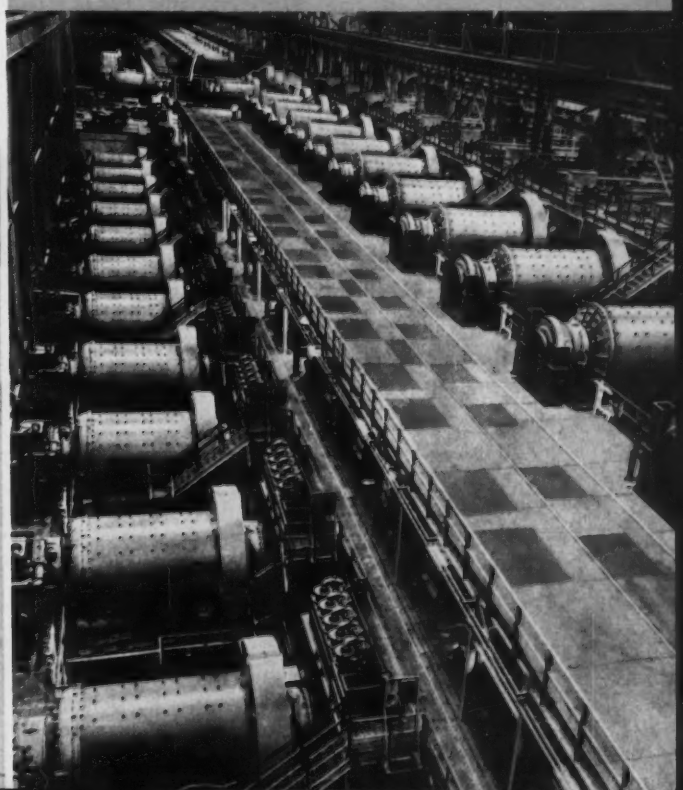
## IN SCREENING

From scalping to fine screening, there is a Symons Screen built to do a better job at low cost. Let Nordberg experience help you select the screen best suited to your needs.



## IN WET AND DRY GRINDING

Nordberg Grinding Mills include Rod, Ball, Pebble, Tube and Compartment types, in sizes from 6' to 13' in diameter and up to 50' in length.

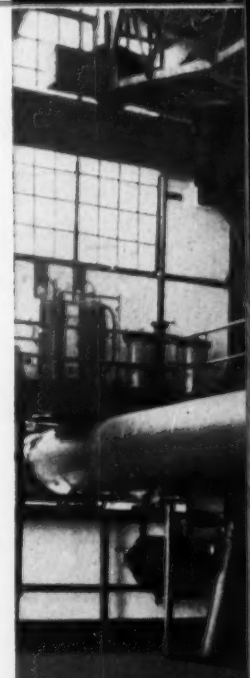


*from URANIUM in SASKATCHEWAN*
*to NITRATES in CHILE . . .*

# NORDBERG ENGINES
## prove their reliability and economy
# in MINING SERVICE

**AT GUNNAR MINES, LIMITED . . .** Neither bitter cold, nor inaccessible location could stop the successful development of a strategically valuable uranium ore deposit by Gunnar Mines, Limited, located in northwest Saskatchewan, less than 450 miles south of the Arctic Circle.

To meet the electrical power requirements for the construction and operation of mine, mill and town facilities, Gunnar chose seven Nordberg Supairthermal® 4-cycle diesel engine-generator units, each rated 1200 hp at 450 rpm, direct connected to 845 kw generators. Adding to the efficiency of this installation are waste heat boilers which utilize exhaust gas from the Nordberg engines to produce steam for heating plant buildings.



**AT ANGLO-LAUTARO NITRATE CORPORATION . . .** The story of power plant expansion for Anglo-Lautaro Nitrate Corporation's vast operations in northern Chile is largely a story of reliable Nordberg power. Their original Nordberg engine was a 7100 hp diesel unit installed in the Pedro de Valdivia plant, followed by the installation of two 1900 hp Nordberg diesels for the plant at María Elena. Then, to meet much needed additional power, two big 9600 hp Nordberg diesels were installed in a new power plant at Coya Sur.

Now Anglo-Lautaro has again turned to Nordberg to meet further power expansion, and has ordered *five more* Nordberg diesels, each rated 5750 hp, to be installed in the Pedro de Valdivia power plant. When these new engines are put in service, the combined generating capacity of all ten Nordberg engines will provide over 38,000 kilowatts for nitrate production.

*While these installations in Saskatchewan and Chile are widely separated geographically, they serve as striking examples of the way in which Nordberg engines are serving the varied power requirements of the mining industry . . . especially in remote areas where dependable operation is of prime importance.*

**NORDBERG MANUFACTURING COMPANY**
**Milwaukee 1, Wisconsin**

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P959

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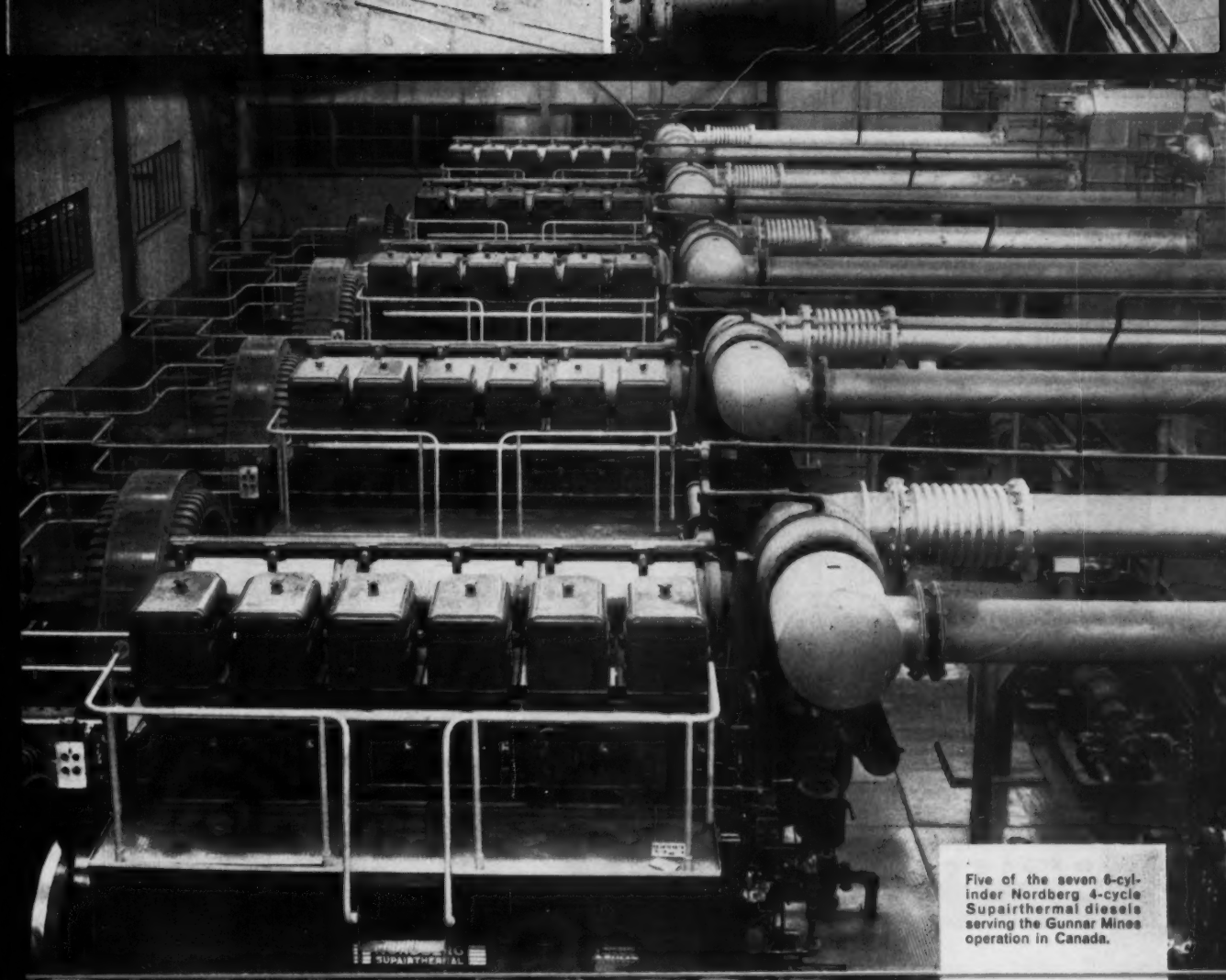
NORDBERG GRINDING MILLS

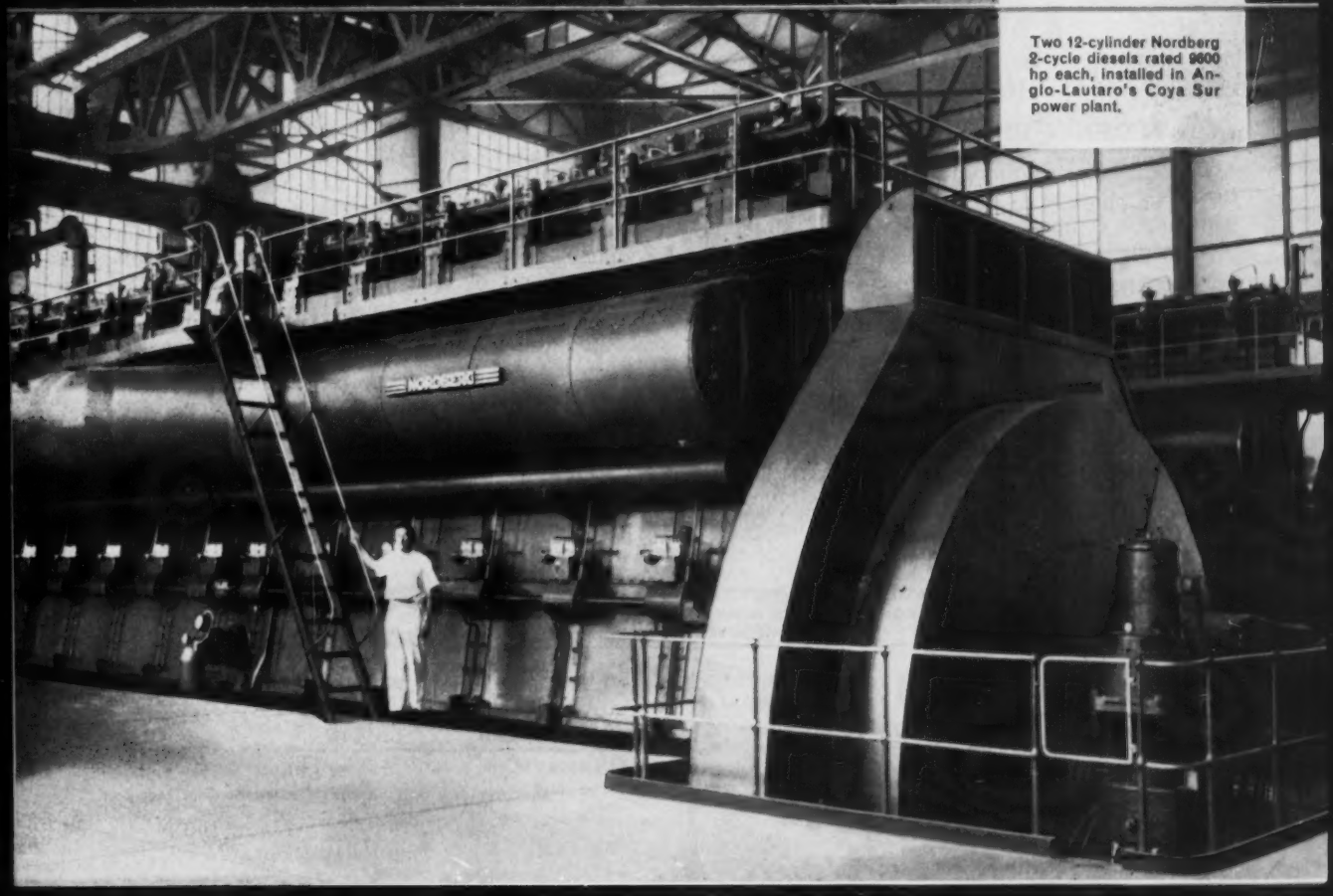
SYMONS VIBRATING SCREENS

SYMONS VIBRATING GRIZZLIES

NORDBERG MINE HOISTS




Five of the seven 6-cylinder Nordberg 4-cycle Supairthermal diesels serving the Gunnar Mines operation in Canada.




Two 12-cylinder Nordberg 2-cycle diesels rated 9600 hp each, installed in Anglo-Lautaro's Coya Sur power plant.

# buy BOSTON belts

*The Right Belt . . . The Best Belt . . . For Every Mining Job*

BOSTON ULTREX* — The new PVC belt with a tough carrying surface and superior impact and flame resistance. Smooth edges stubbornly resist edgewear. By actual test, this more compact specially-designed, single-ply carcass has best fastener-holding ability.

BOSTON FLAMEOUT 200* — Single-ply, flame resistant belt with maximum impact resistance, outstanding edge wear, and fastener holding strength. Has neoprene covers. No slipping on pulley. Improved wear-resistant cover available in any thickness. Ideal for panel and continuous miner installations.

BOSTON COLLIERY KING — Balanced Belt Construction with Dulon covers for longest service life in preparation plants and all above-ground coal handling.

BOSTON SUPER BOSTRON — Balanced Belt Construction, with Dulon or Flameout covers for severe impact and high tension belts. Ideal construction for longest service life on slope conveyors. Strong, thin carcass allows smallest diameter rolls for low coal removal. Carcass will not rot or mildew.

BOSTON FLAMEOUT* — Balanced Belt Construction for permanent underground installations and main entries having special tension requirements.

*Fire-resistant — maximum underground safety. Meets standards of U. S. Bureau of Mines Acceptance Designation No. 28-9.

Whatever your requirement, BOSTON has the right belt for the job — assuring you longer belt life . . . less trouble in service . . . greater economy!

AMERICAN BILTRITE RUBBER COMPANY
BOSTON WOVEN HOSE & RUBBER DIVISION
BOSTON 3, MASSACHUSETTS

BOSTON

# Simplex PRODUCTS GUIDE

SIMPLEX WIRE & CABLE CO., CAMBRIDGE 39, MASSACHUSETTS, U.S.A.

**Simplex ANHYDREX Insulated Cables** for Power transmission and Communication (like the Simplex TIREX Portable Cords and Cables shown in adjacent column), though manufactured as stock products, are custom designed to suit all service requirements. A large technical and engineering staff at Simplex' main plant is equipped to give you the benefits of their long experience in electrical cable planning.

**ANHYDROPRENE** — Simplex ANHYDROPRENE Cables are designed for economical installation in ducts, conduits, racks, trays and raceways. Stock sizes AWG 14 to 1000 MCM are recommended for 90 C service in WET or DRY locations. The words "Simplex ANHYDROPRENE" are either printed or molded plainly on the jackets of all ANHYDROPRENE cables. This marking signifies the traditionally high quality of a Simplex product.

CATALOGUE #1028

**ANHYDREX-NEOPRENE** — Simplex ANHYDREX-NEOPRENE Cables have the added mechanical protection of a heavy wall of neoprene jacketing. These cables are manufactured for use in aerial installations and for direct burial service. Stock sizes AWG 14 to 1000 MCM are recommended for 90 C service in WET or DRY locations.

CATALOGUE #1028

**ANHYDREX-PLASTEX** — Simplex ANHYDREX-PLASTEX (ANHYDREX-insulated, PLASTEX-jacketed) Cables are scientifically designed for compatibility between insulation and jacket, and for perfectly balanced performance in ducts, conduits, aerial and direct burial installations. ANHYDREX-PLASTEX Cables are recommended for service in a number of environments but especially where oils and chemicals are a problem.

CATALOGUE #1028

**ANHYDREX Insulated Control Cables** — Simplex ANHYDREX Control, Signal and Communication Cables have an additional thickness of appropriately coded neoprene over each individual conductor, plus heavy-duty neoprene jackets. ANHYDREX insulation provides excellent signal reproduction and is exceptionally stable, even when operating with high ambient temperatures.

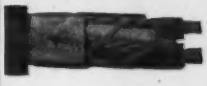
CATALOGUE #1028

**ANHYDREX XX** — Simplex ANHYDREX XX is a butyl-based insulation of the highest possible quality. Because of its exceptional resistance to heat and ozone, it has general applications in circuits operating up to 35,000 volts, with permissible conductor temperatures of 90 C. to 5KV, and 85 C to 17KV — in wet or dry locations.

CATALOGUE #1023

**CONDEX** — Simplex CONDEX Cables are protected against mechanical damage by interlocked metallic armor. The armor is manufactured of galvanized steel, plain or baked enameled (colored) aluminum, bronze or other metals, and can be applied over any cable core within a very wide diameter range. CONDEX Cables may be further protected by a thermoplastic covering over or under the metallic armor.

CATALOGUE #1024



**TIREX SO and SJO Cords** — TIREX SO and SJO Cords are constructed to meet the most rigid specifications. All of their special features are carefully selected and processed to give maximum qualifications for portable service. They will twist without kinking, and bend without breaking. TIREX stranding affords maximum flexibility without sacrificing strength.

Conductor temperature rating 75c

CATALOGUE #992

**TIREX Low Voltage Portable Cables** — TIREX Low Voltage Cables are individually designed for specific applications. They are practically indestructible when used to do the work for which they are intended.

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**TIREX High Voltage Portable Cables** — TIREX High Voltage Portable Cables have unequaled strength and versatility. Designed primarily to transmit energy to mobile electrical equipment, they are also used as temporary power lines during alterations or emergency repairs.

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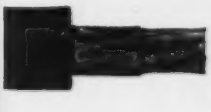

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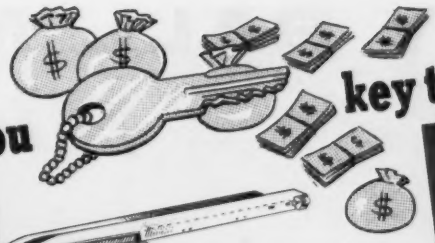

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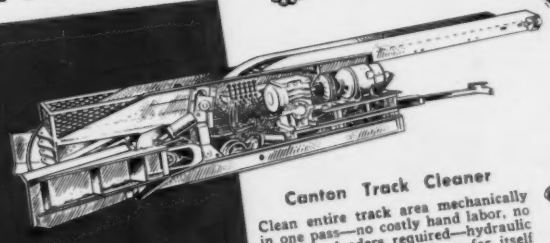

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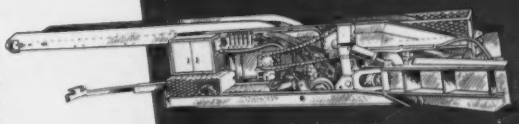

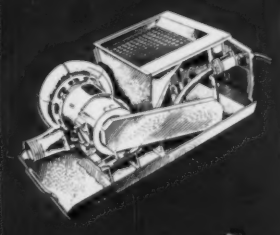

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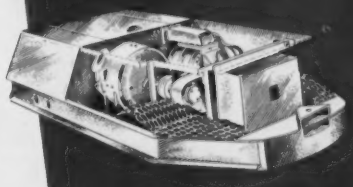
Weighs only 280 lbs. Easily moved on shuttle car. Hand cart available. Ideal for small mines—inexpensive—capacity 7 tons dust per shift.



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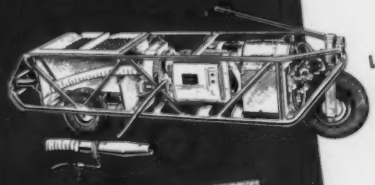

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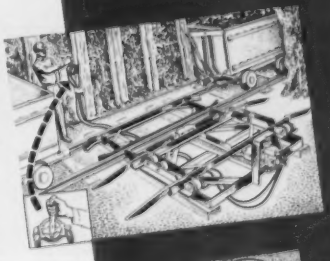

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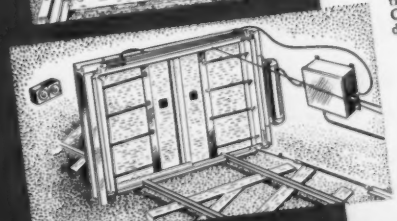

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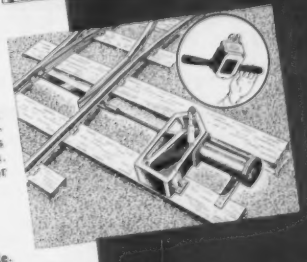

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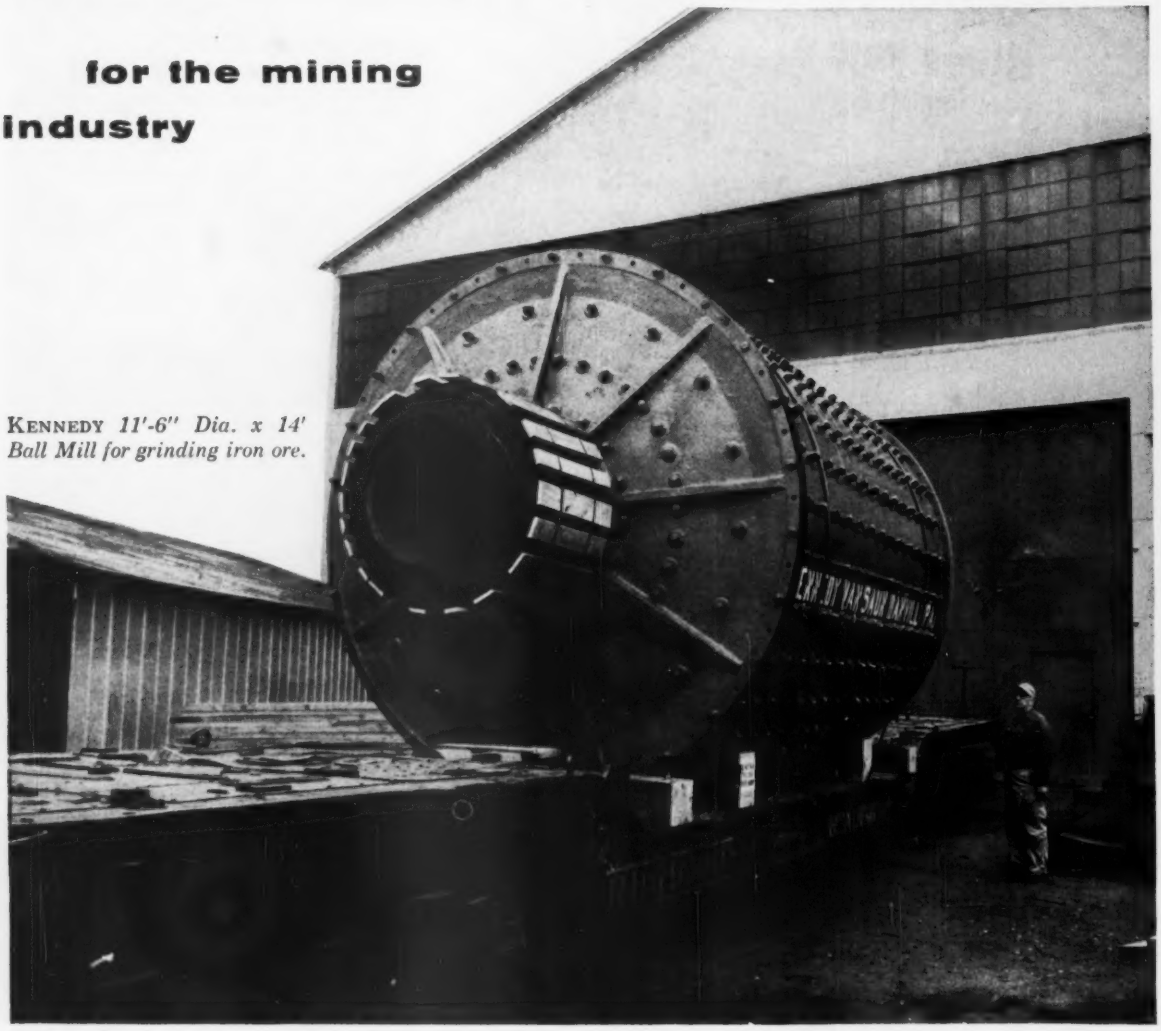

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There's double action in Timken® threaded carbide insert bits that speeds chip removal, cuts your costs. The 5 front hole design, pioneered by the Timken Company, shoots air or water straight against the rock face. Then, the deeper, wider wing clearance lets chips wash back faster. Result is you eliminate time-wasting, chip-clogging of bits. Drillers can cut more rock, spend less time drilling chips.

Another big dollar saver for you is: the special analysis carbides in Timken bits have extra resistance to shock and wear. They are securely bonded to the bit body, can be reconditioned many times. And bit bodies have added strength because they're made of Timken fine alloy steel.

Besides these money-saving advantages, users of Timken bits get on-the-spot service from Timken Company field engineers . . . the kind of service you can't get anywhere else. That's why Timken bits are used by more miners—more than any other removable bit.

To get more hole-per-bit use Timken threaded carbide insert bits on your drifters, sinkers and stopers. Complete range of bit sizes and types. Send for detailed, free brochure, "Timken Removable Rock Bits". The Timken Roller Bearing Company, Rock Bit Division, Canton 6, Ohio. Cable: "TIMROSCO". *Makers of Tapered Roller Bearings, Fine Alloy Steel and Removable Rock Bits.*

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EXPLORATION

# Structural Deformation and Ore Deposits

## Oklahoma-Kansas Mining Field in Tri-State Mining District

GEORGE M. FOWLER

THIS ORE SEARCH AND DEVELOPMENT problem was solved progressively after several years of study of the relationship of stratigraphy, structural deformation and metamorphism in this field. Techniques developed in this study have been applied by geologists from this office with equal merit in numerous mining districts in the United States and in Canada and Mexico.

A blanket of sediments several hundred thousand square miles in extent covers part of the Central States. Three major zinc and lead mining districts – the Tri-State, Southeast Missouri, and Upper Mississippi Valley – are within this area. In and around these districts the sediments cover the Basement complex from zero feet to about 2,500 ft in thickness. In the region as a whole zinc and lead ores were mined from the surface to a depth of about 1,000 ft and their average depth is about 500 ft below the surface.

The structural deformation patterns in the above mining districts developed zones of adjustment that trend northwesterly, northeasterly, and locally easterly and northerly, all probably resulting from northerly-southerly regional compression. The larger ore deposits in these districts are within these zones and nearly all of the ore deposits conform to those general patterns.

Each of the above districts were discussed by the writer and associates in earlier publications. This paper amplifies previous statements regarding the Oklahoma-Kansas field of the Tri-State District, particularly its structural features and their relationship to ore deposits.

The Oklahoma-Kansas field, discovered in random drilling in 1915, shows no surface manifestations as the Mississippian formation in which the ore depoits localized is mantled by Pennsylvania shales and sandstones that vary in aggregate thicknesses from a few feet to more than 200 ft. These formations have an average northwesterly dip of about 25 ft per mile. Mining operations were suspended in July 1958 because of low zinc and lead prices.

Peak production of the district was in 1926 when 423,800 tons of recoverable zinc and 102,117 tons of recoverable lead were produced.

The Oklahoma-Kansas field with a production in excess of one billion dollars was the source of more than 75% of the total zinc and lead pro-

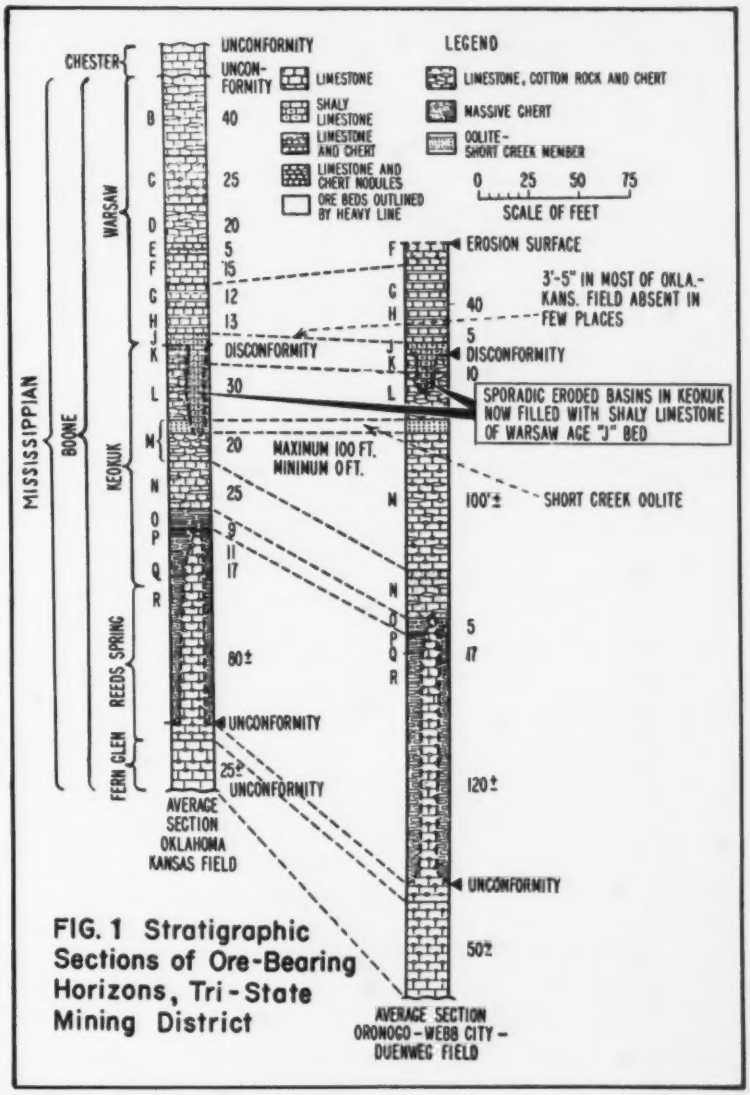
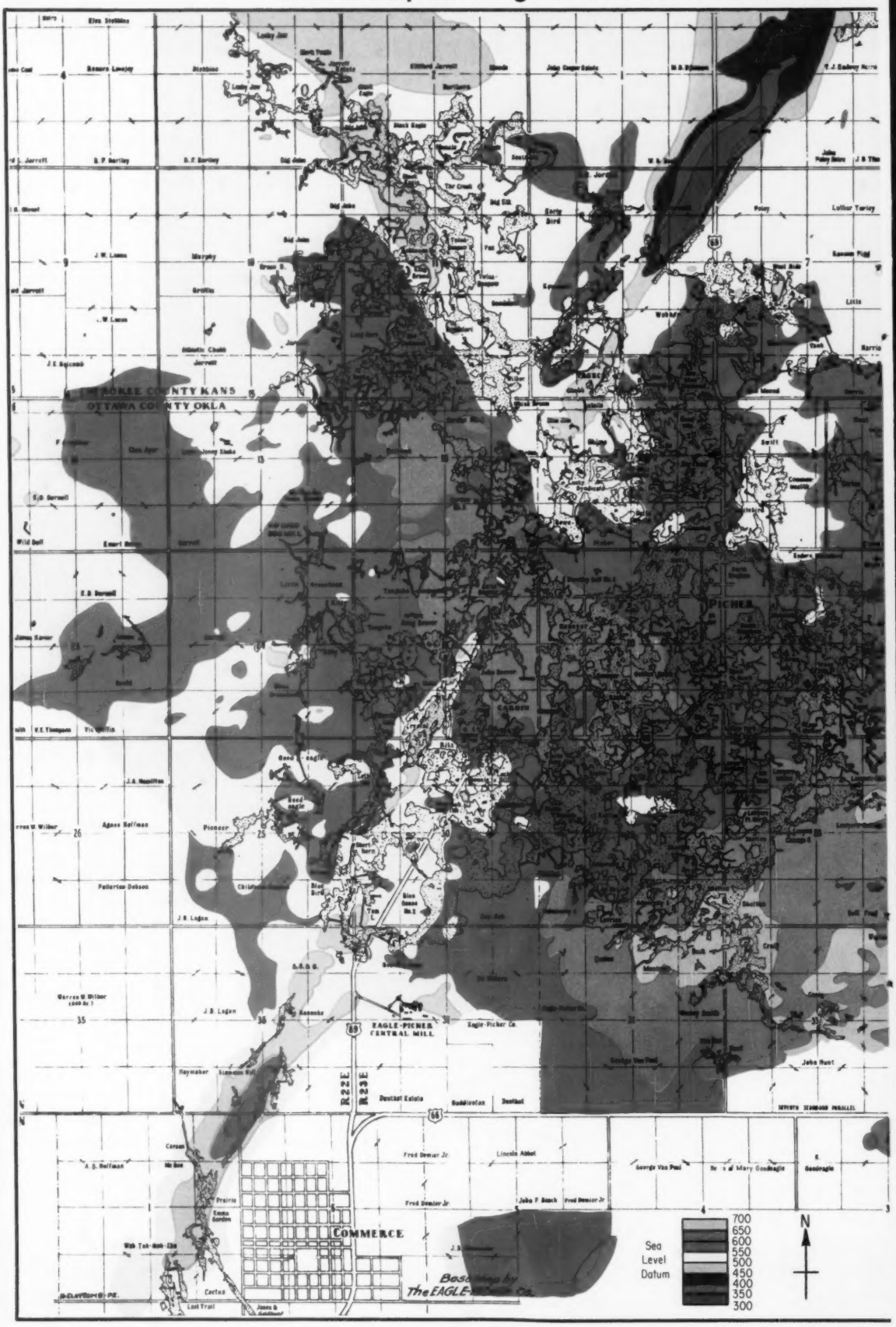



**FIG. 1 Stratigraphic Sections of Ore-Bearing Horizons, Tri-State Mining District**

**STRUCTURE CONTOUR MAPS** of several horizons in the above sections greatly simplified the ore search investigations in the Tri-State district.

Mr. Fowler is a consulting geologist with offices in Joplin, Missouri. A previous article prepared by Mr. Fowler and Associates, "Prospecting and Developing Ore Deposits in Bedded Formations," E&MJ, March 1955, pp 6-18, contains much useful information supplemental to this article.

## Tectonic Map Showing Structure Contours on Bottom



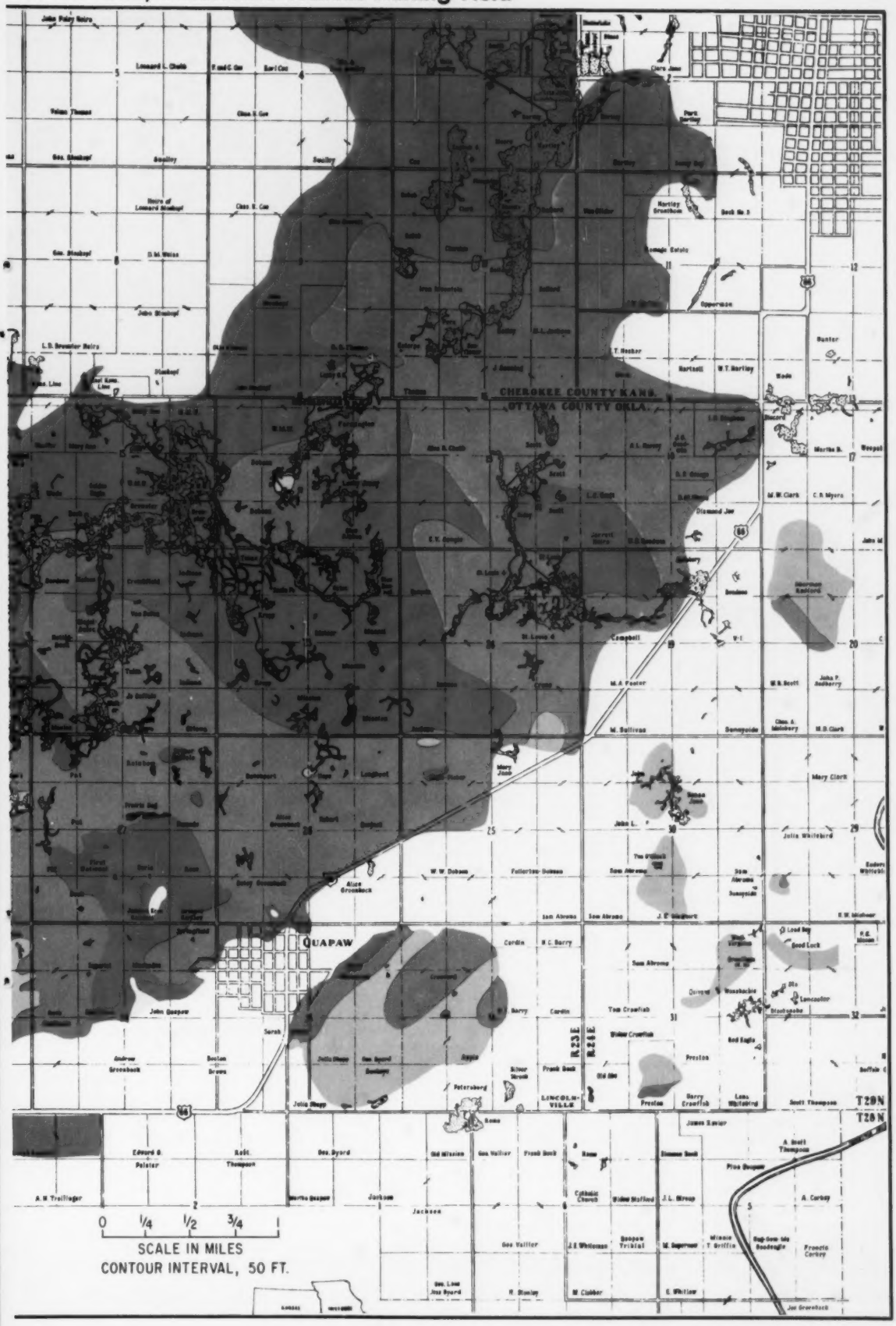



**Fig. 2** Tectonic map. The base map was prepared by the Eagle Picher Co.

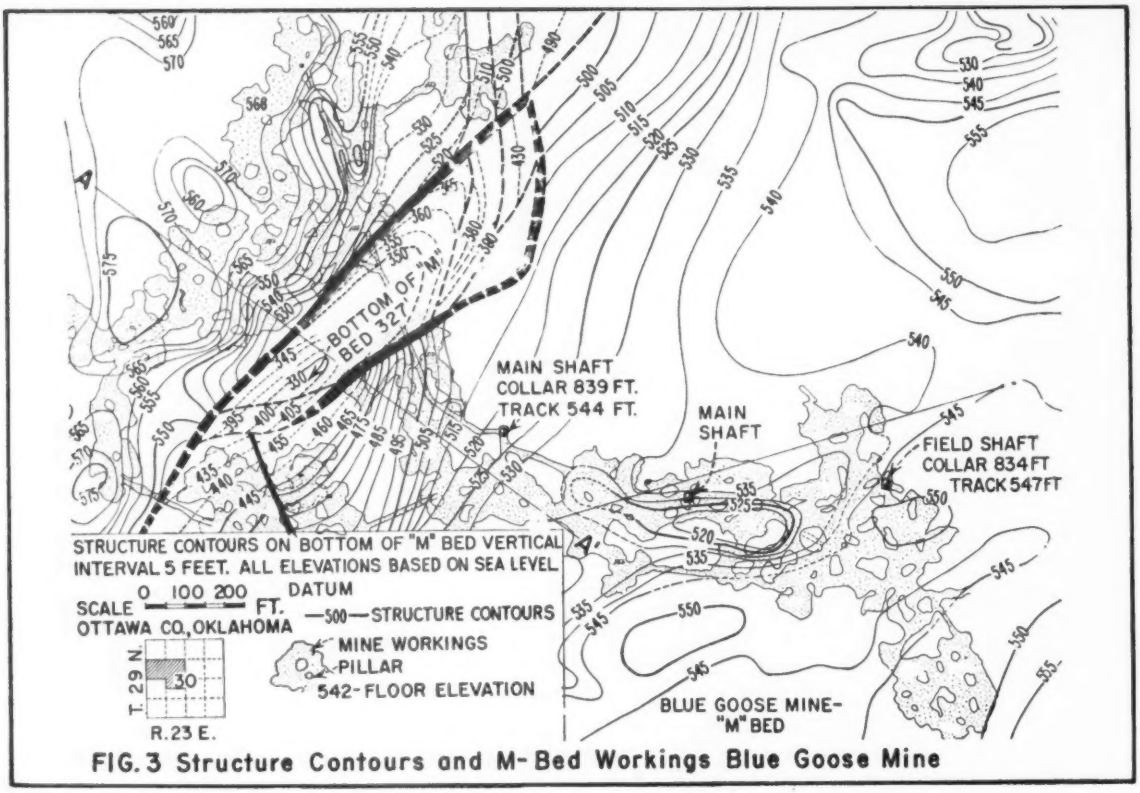

BOTTOM OF "M" BED 327'
MAIN SHAFT COLLAR 839 FT. TRACK 544 FT.
MAIN SHAFT
FIELD SHAFT COLLAR 834 FT TRACK 547 FT
BLUE GOOSE MINE- "M" BED
STRUCTURE CONTOURS ON BOTTOM OF "M" BED VERTICAL INTERVAL 5 FEET. ALL ELEVATIONS BASED ON SEA LEVEL DATUM
SCALE 0 100 200 FT.
OTTAWA CO., OKLAHOMA
—500— STRUCTURE CONTOURS
MINE WORKINGS
PILLAR
542- FLOOR ELEVATION
T. 29 N.
30
R. 23 E.

**FIG. 3 Structure Contours and M-Bed Workings Blue Goose Mine**

For location of this area, see tectonic map (Fig. 2) SW ¼, NW¼, Sec. 30, T. 29 N., R. 23 E., Oklahoma.

### Production of Tri-State District, 1907-1958*, Inclusive

(Compiled from U. S. Geological Survey and U. S. Bureau of Mines statistics.)

| | Material Milled (short tons) | Concentrates Produced (short tons) Zinc | Lead | Conc. Recovery (per cent) Zinc | Lead |
|---|---|---|---|---|---|
| From crude ore | 396,000,299 | 17,547,549 | 2,865,068 | 4.43 | .72 |
| From old tailings | 152,505,326 | 1,309,289 | 10,775 | .86 | .007 |

| | Recoverable Metal (short tons) Zinc | Lead | Recovery (per cent) Zinc | Lead |
|---|---|---|---|---|
| Produced, 1907-1958*, inclusive | | | | |
| Tri-State mining district | 9,528,526 | 2,221,863 | | |
| UNITED STATES | 28,623,825 | 23,256,286 | | |
| Percent of production by Tri-State mining district | | | 33.29 | 9.55 |

*1958 production figures for United States are preliminary, all Tri-State figures are final.

duced in the Tri-State mining district which approximates 2,000 sq mi in extent. All of these deposits are definitely related to structural deformation.

## Stratigraphy

The stratigraphic sections, Fig. 1, comprise more competent and less competent strata, and the latter are the common loci of most of the ore deposits because they are thin-bedded with numerous stylolite partings. Consequently they were more readily deformed and replaced by ore-bearing media. These less competent beds flexed, wrinkled, and shattered intensely and were replaced in part by chert and dolomite, then sporadically by zinc and lead ores. Many of the ore-bearing zones, within these strata developed in intensely stressed flexures and thus are confined largely to the thin-bedded strata. These beds comprise D, E, G, H, K, and M. The more competent strata, L, N, O, P and Q beds, are thicker-bedded with few stylolite partings and thus better resisted deformation except in very strong transecting shear zones.

The irregular, saw-toothed disconformity between R and the overlying beds in contact with it is an ore-bearing horizon in parts of the Oklahoma-Kansas field. Blanket (sheet ground) ore deposits, 5 to 20 ft in vertical thickness, localized sporadically on this contact.

## The Sedimentary Series and The Basement Complex

According to present knowledge the pre-Cambrian Basement complex, which underlies the sedimentary series in which the ores of the Oklahoma-Kansas field localized, varies in depth below the surface from approximately 290 ft on the Demo land in the extreme southwest part, four miles northwest of Miami, Okla., to 1,760 ft along the flank of the Miami shear through in the west-central part of the field. The Eagle Picher Co. drill hole No. 159 in

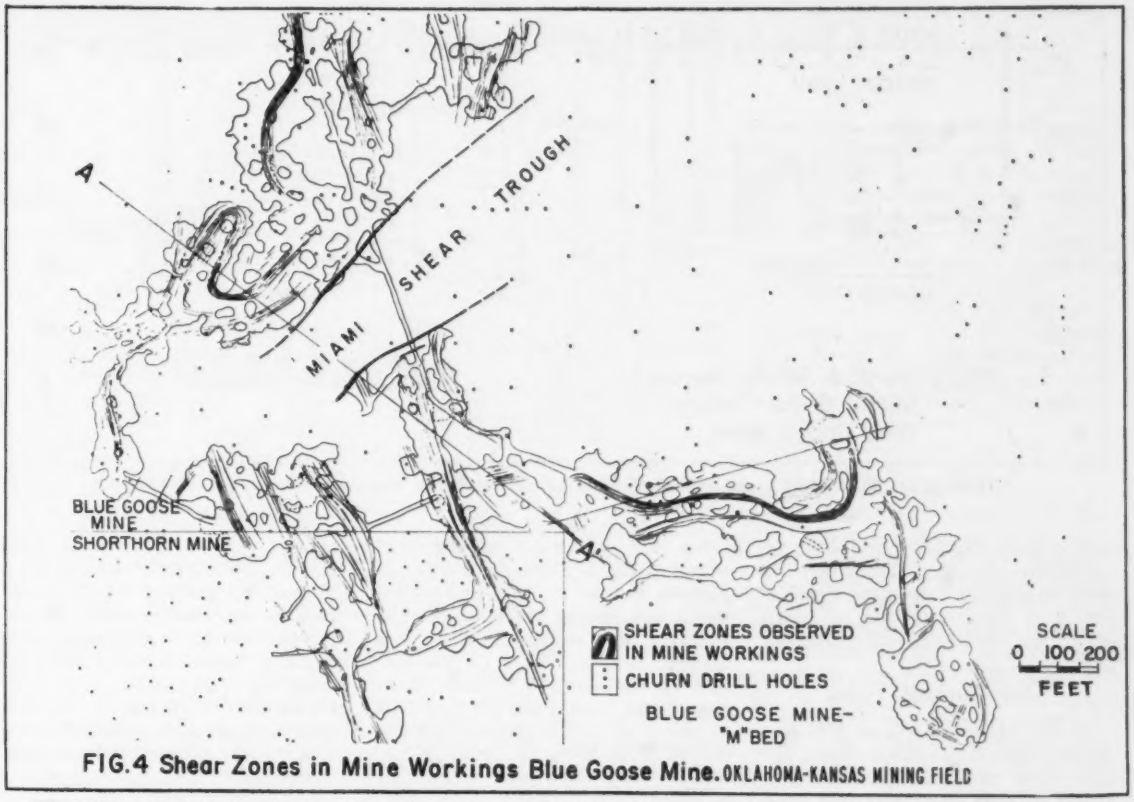



FIG.4 Shear Zones in Mine Workings Blue Goose Mine. OKLAHOMA-KANSAS MINING FIELD

**SHEARED AND SHATTERED STRATA** are particularly favorable reservoirs for ore deposition in the Tri-State district.

the west-central part of the field. The Eagle Picher Co. drill hole No. 159 in the west shaft of the John Beaver mine—located SW. ¼, SE. ¼, Sec. 19, Twp. 29 N., R. 23 E., Oklahoma—penetrated the Basement complex granite at a depth of 1,760 ft below the surface. A hole at the Bird Dog mill site—located SE. ¼, SE. ¼, Sec. 13, T. 29 N., R. 22 E., Oklahoma—penetrated the Basement complex at a distance of 1,185 ft below the surface. Ten or more additional holes penetrated the deeper sedimentary horizons to utilize the water from several sandy horizons. A few of these holes were drilled to the Basement complex and their depths range within the limits stated above.

## Tectonics

The tectonics map, Fig. 2, shows the Oklahoma-Kansas field and some of the structural features that localized its ore deposits. The map was developed in this office from knowledge gained by appraising more than 40,000 churn drill holes, cuttings and logs, and from thousands of underground observations recorded in nearly every mine in the field. Almost all of the structure contouring was done on 5-ft vertical intervals as small ore deposits were localized by less than 10 ft of vertical structural deformation.

Two outstanding structural features of this field are shown on Fig. 2, namely, the Miami shear trough (with included grabens) that strikes northeasterly across the field and the Bendelari trough that trends northwesterly from near the center of the field.

Stratigraphic sections of the beds of the ore-bearing horizons in the Oklahoma-Kansas and Oronogo-Webb City-Duenweg fields in the Tri-State mining district are shown on Fig. 1. These strata of Carboniferous age were deposited as limestone, then progressively deformed in small to large areas by flexing and shearing, shattered and chertified in varying degrees, each influenced largely by their proximity to the centers of structural deformation and successive introduced solutions. All of these cycles occurred in Mississippian times as the overlying Chester (late Mississippian) is not chertified and is much less deformed than the older formations.

The original data were posted on maps that represent 160 acres on a scale of 100 ft to the inch and cover nearly the entire Oklahoma-Kansas field. The underground workings and structure contours in relation to ore deposits of the Blue Goose mine—located NW. ¼, Sec. 30, Twp. 29 N., R. 23 E., Oklahoma—are shown on Figs. 3 to 5, inclusive.

The strata in parts of this field are more extensively and intensively flexed, sheared, shattered and dolomitized than in any other part of the Tri-State mining district and these conditions prepared parts of the strata as particularly favorable reservoirs for ore deposition.

Maximum structural relief in the field as a whole is 350 ft vertically and the flexures vary from several feet to about 100 ft in vertical deformation.

Many characteristics common to oil fields, such as anticlines, synclines, domes, basins and allied structures, are present here on a minor scale. A thick residual oil occurs locally in very small volume in the Pennsylvanian shale that overlies these ore deposits.

Throughout the field nearly barren "islands" fractions of an acre to many acres in extent are in evidence in M

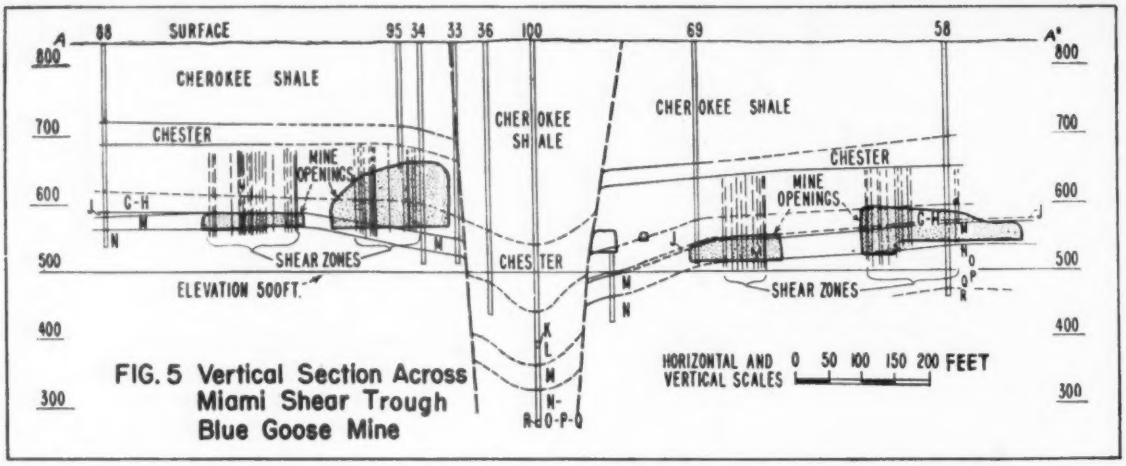



**FIG. 5 Vertical Section Across Miami Shear Trough Blue Goose Mine**

**STRATA IN THIS AREA** are extensively and intensively flexed, sheared, shattered and dolomitized.

and K beds; they comprise segments of partly chertified limestone that were by-passed by the many trends of structural adjustment and by nearly all of the introduced mineralization.

## Ore Deposit Types

In the Oklahoma-Kansas field flexing and shearing in Mississippian and later times deformed the strata progressively, thus developing very irregular sponges in which the ore media deposited in Pennsylvanian or later times. These ore deposits are partly bedded and partly in nearly vertical shear zones. Bedded ore deposits localized in thin beds between massive strata and in disconformities in parts of the field.

In parts of the Oklahoma-Kansas field the ore deposits are confined largely to shear zones, in some cases to one or more of the less competent strata, and in others competent and incompetent strata 100 ft or more in thickness are sheared and are ore-bearing. In the Pioneer mine, near the center of Sec. 25, Twp. 29 N., R. 22 E., Oklahoma, a vertical shear zone more than 1,000 ft long and over 125 ft wide penetrated all of the beds from deep in R to C, a distance of about 150 ft, and produced ore sporadically throughout that thickness.

Ore deposits in shattered cores or encircling barren solid cores of partly chertified limestone are present in the Oklahoma-Kansas field and about a dozen of them are known. They involve one to several of the beds shown in Fig. 1. These cores were apparently formed by rotational adjustments but require more study. The shattered cores are less than 100 ft in diameter and are more or less ore-bearing. Cores 100 ft or more in diameter and from about 25 to 100 ft in height are usually barren and the ore encircles them in doughnut-like deposits that range from a few feet to about 35 ft in width, particularly in the favorable beds.

Larger diameter cores are known in the Tri-State mining district, an example being the Oronogo Circle mine 10 miles north of Joplin where ore 50 ft or more in width encircled the 1,000 ft core at vertical intervals and also localized in gravity shear zones within the core.

## Future Prospecting

It is probable that the important ore deposits in the known ore bearing horizons in the Oklahoma-Kansas field and in the Tri-State mining district have been discovered as prospecting has been intensive and widespread and covers nearly all of the district. Relatively little prospecting has been done in southwest Missouri outside this district and the structural conditions that localized these ore deposits extend far beyond its limits. East and south of it, favorable ore bearing strata have been partly eroded in some areas, and intense structural deformation, one essential for these ore deposits, is confined to small areas. New ore discoveries may be found to the west and north of the district beneath the shale and sandstone covering, particularly if structural deformation patterns in the sedimentary formations or in the Basement Complex inferred or defined by geophysical methods are favorable. Such areas could then be prospected by employing established drilling methods.

## Deep Drilling Needed

Except in a few random drill holes, prospecting the sedimentary beds that underlie the established ore horizons has never been undertaken in the Oklahoma-Kansas field nor in other parts of the Tri-State Mining District and assays of the cuttings from this drilling were barren or low grade.

In the Tri-State Mining District and outward from it for many miles less than two dozen drill holes have penetrated only a few feet into the Basement complex and nothing is known regarding ores that may be found there. Earlier papers by the writer and associates favor a deep-seated source for the known ore deposits and cite the orderly and unrepeated sequence of the cycle of metamorphism and mineralization to support this thesis. Future deep prospecting would be very helpful in establishing the source of these ores and the structural deformation patterns that probably exist in the Basement complex, some of which may indicate ore deposits.

# The Origin of Sulphide Ores

## Synopsis

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**Conclusion**

**C. J. SULLIVAN**

## Introduction

IT WOULD BE DIFFICULT, if not impossible, to cover within the space of a short paper all of the considerations relating to the origin of sulphide deposits. In the present paper, an attempt is made to sustain two general ideas:

A. That particular sedimentary environments produce particular types of metalliferous provinces, as do the various types of basic igneous rocks.

B. That the formation of thermal sulphide ores, as distinct from syngenetic ores, results principally from the application of heat to bodies of rock containing dispersed quantities of metals—a process akin to distillation. The separation of sulphide and silicate phases depends on relative thermal stabilities, not on solubility in water.

## The Geological Environment of Ore

The hydrothermal theory does not recognize adequately, if at all, the great importance of sedimentational or other general geological environments for the localization of metalliferous provinces and deposits. Below are discussed some of the factors which have been found to be important in this respect.

Mr. Sullivan is president of Kennco Explorations (Canada) Ltd., Toronto. This paper was originally presented at the annual meeting of the Canadian Institute of Mining & Metallurgy, April 1959, and is here published with the permission and through the courtesy of C.I.M.M.

### PROVINCES CO-EXTENSIVE WITH SEDIMENTS

A large proportion of lead-zinc provinces, many copper-lead-zinc provinces, and most uranium provinces are co-extensive with particular sedimentary groups of rock, usually of a particular facies.

Each sedimentary environment tends to produce a characteristic type of mineralization.

#### Lead-Zinc Ores in Limestone

A Canadian example of a lead-zinc province of this nature is that contained in the Pend d'Oreille limestone of British Columbia. Deposits include the Reeves-McDonald, Emerald-Jersey, H.B., and Jackpot. This limestone is of Paleozoic age. A similar province occurs in the Mesozoic limestone of the Slocan area, where the Payne, Victor, Lucky Jim and other deposits occur in a particular stratigraphic unit.

The sedimentation in both cases is characterized by alternating limestone and argillite, and in each case the concentration of the ore is associated with the formation of granite. Tungsten is common in this environment.

#### Massive Pyritic Zinc-Lead-Copper Ores in Marine Shales and Tuffs

The massive sulphide ores of New Brunswick furnish a good example of ores in this category. There are numerous other examples, but this province is well known to many of the present audience.

The province as a whole is co-extensive with certain sedimentary and tuffaceous formations, which are also associated with lavas. It may be noted that, in contrast to the beds described above, the proportion of lime is low, and the ores also differ distinctly from those of the British Columbia examples.

The New Brunswick ores, in common with many of this type, are characterized by a high proportion of pyrite, which is usually the principal mineral present. The next most abundant mineral is sphalerite, and the ores may contain from 5 to 10% zinc. There is, in most cases, up to 2% lead, and an average of about 0.75% copper. There are deposits in the district which are exclusively copper-bearing; examples are the Kennco Clear and the Texas Sulphur deposits. Although these ores occur in close association with the massive ores described above, they themselves are not of massive pyritic type, and consist of chalcopyrite and pyrrhotite disseminated in a chloritic sediment. These ores have characteristics reminiscent of purely sedimentary deposits, but they have undergone metamorphism.

The New Brunswick-type deposit has recently been described by R. L. Stanton, [5] who gives the following account of its typical geological setting:

> "The ores occur in marine shales, tuffaceous shales, or tuffs of a marine sequence; most frequent occurrence is in carbon-bearing shales (often with a substantial fragmental volcanic content) close to the contact of these with a major volcanic unit. In some cases, enclosing rocks have clearly been deposited near old shore lines."

As shown by Stanton, this class of deposit occurs in various parts of the world, and the enveloping sediments remain relatively constant in type.

The ore deposits themselves are commonly concentrated in structural foci—in many cases, in folds in the enclosing sediments. They may be associated also with the developing of porphyritic rocks. In the case of New Brunswick, the porphyries, which are closely associated with mineralization, are thought to be porphyroblastic rocks, of metamorphic origin. The development of the porphyry is probably associated with the concentration of the ore. However, some of the "porphyries" are tuffs of volcanic origin.

### Ores in Reef or Near Reef Facies

There is a widespread correlation between certain types of metalliferous provinces and algal or coralline reefs.

Thus, in Missouri, the lead deposits are closely associated with reefs in the Bonne Terre formation, the reefs forming rings around former islands in the Cambrian Sea. The degree of folding is small, and metamorphism is slight. In truly thermal replacement deposits in limestone, skarn minerals are present; but there is no sign of skarn in many typical reef deposits.

The Pine Point lead-zinc ores represent another typical case of reef association, and there are many other examples.

Why some ores contain lead only, while others contain mainly zinc, is not known. Perhaps it has something to do with the type of organism which built the reefs.

Less well-known than the lead-zinc association is the occurrence of copper in such an environment. Thus, some of the Katanga[4] copper-cobalt-uranium ores are in shales immediately associated with algal reefs. In the Rum Jungle[2] copper-uranium-cobalt province of Australia, ore-bearing black shales immediately overlie erosion breccias derived from reefs. Some of the ore is found in the reef breccias. The similarity of the metal association in these two localities should be noted. Lead is found in adjacent formations, in places, in substantial quantity.

There is a suggestion (B. P. Walpole, personal communication) that the great Mt. Isa [1] copper and lead-zinc deposits, of Northern Queensland, occur in beds deposited under similar conditions, and at about the same time, as the Rum Jungle formations. The copper mineralization occurs in a dolomite breccia, which, under this interpretation, is regarded as being of sedimentary origin. The lead-zinc mineralization is in finely banded shale, and parallels the laminae of this rock. It is very similar to the Sullivan ore at Kimberley, British Columbia. The lead-zinc ore is adjacent to, but separate from, the copper deposits.

### Red Bed Environment

Continental formations, deposited under alternate oxidizing and reducing conditions, constitute a further and well-recognized sedimentary environment, under which a particular type of metalliferous province may occur. Characteristic is the presence of copper, and less commonly, uranium. Examples are too well known to cite here.

### Aeolian Environment

It is considered significant that sulphide provinces are not found in aeolian sediments: such provinces occur only in sediments deposited in water.

### General

There is thus a clear suggestion that specific types of sedimentary environment tend to produce specific and characteristic types of metalliferous provinces. The hydrothermal solution theory provides no adequate explanation of these phenomena.

## PROVINCES CO-EXTENSIVE WITH BASIC IGNEOUS ROCKS

### Zinc-Copper Ores, Associated with Basic Intrusives

There is a widespread type of massive sulphide ore, usually low in lead but containing zinc or copper-zinc. In any given district there may be deposits which are rich in copper and low in zinc, while others are essentially zinc deposits.

For these ores, there is no association with particular sedimentary groups; on the other hand, basic igneous rocks, often post-metamorphic in age, are a relatively constant association. A further common accompaniment is the presence of magnesium-iron metasomatism, which shows a close association with the ore deposition. The basic rocks appear to be closely associated in time and place with the ore deposition. The Noranda-Mattagami copper-zinc province is a Canadian example.

### Nickel and Nickel-Copper Ores

Geologists have for generations recognized that basic igneous rocks are rich in nickel relative to most other rock types, and that nickel deposits show a close association with such rocks. Ultra-basic rocks usually yield nickel ores, while the gabbroic type yields nickel-copper ores. Again none of this is new.

The point which I wish to emphasize is that the concentration of massive nickel and nickel-copper ores from the basic igneous source rocks may be due, in some important instances, to metamorphic and granitization processes—not simply to the cooling of the basic rock.

Thus, the Thompson nickel deposit of Manitoba is completely surrounded by paragneiss of metamorphic origin, and is about a mile south of a peridotite body. The peridotite contains nickel and also is the locus of several major concentrations of this metal. However, the Thompson, as well as other deposits in the district, are found in the granitic environment. In some areas in which nickel has been found, primarily within the paragneiss, what appear to be metamorphosed remnants of peridotite have been observed. For the most part, the above information has been supplied by various Government geologists who have worked in these areas, and by the staff of Kennco.

My interpretation of these observations is that the nickel-bearing peridotite has been transformed by post-peridotite granitization. In some instances, the nickel has been concentrated, along with iron sulphides, during this latter process.

### General

It is not presumed that the above examples illustrate the complete range of types of sulphide deposits. The processes of ore formation are not simple, but diverse. The examples are meant to suggest some aspects of the matter perhaps not generally appreciated.

## Mechanisms of Concentration

As suggested by the above remarks, the mechanisms of ore deposit concentration might be divided into two principal types: (A) primary concentration in igneous rocks or in sediments; (B) secondary concentration, principally by thermal distillation. These mechanisms are not assumed to cover the whole range of ore deposits, but they may cover major classes of the deposits under discussion.

## PRIMARY CONCENTRATION

Remarks under this heading are brief, partly because we mining geologists know very little as yet concerning the part played by sedimental or biological processes in the accumulation of metals. However, there are some suggestive empirical data.

### Availability of Sulphur During Sedimentation

It is well known that sedimentary processes give rise to the accumulation of sulphur, sulphates and sul-

phides. The large sulphur and gypsum deposits often associated with evaporites, such as salt, are characteristic of shelf or lagoonal sedimentation, and attest the presence of sulphur during sedimentation. The conditions prevailing in the Black Sea are known to be conducive to the generation of large quantities of $H_2S$, and to the precipitation of sulphides. Many natural gases are rich in sulphur, a circumstance which frequently makes them sour or difficult to exploit.

It has been suggested that the sources of the sulphur include the generation of sulphate waters on decaying land masses under comparatively arid conditions, the decay of sulphur-rich organisms, and the addition of sulphur to sea waters by volcanic activity. In any case, there is sufficient sulphur in certain sediments to form any sulphide ore deposits of which we are aware.

Furthermore, where ore deposits form in sedimentary environments, the facies may be somewhat similar to those giving rise to the accumulation of gypsum and other sulphur-rich materials. Thus, there are gypsum casts in the sediments associated with the Rhodesian ores; evaporites occur above the reefs carrying the Pine Point lead-zinc ores; and in the Paleozoic of Novia Scotia, which contains extensive gypsum, salt and barite, some formations are rich (geochemically speaking) in syngenetic copper and uranium while others contain lead and zinc. These are rather random examples of a numerous class.

## SECONDARY (THERMAL) CONCENTRATION

The concentration of most massive sulphide ores is associated with heat processes. It was argued in a previous paper [7] that temperature zoning and paragenesis reflect the thermal stability ranges of the minerals, not their relative solubilities in aqueous solutions. The various components of the sulphide facies obey laws similar to those governing the metamorphic facies [3]. Favorable beds and favorable structure depend on susceptibility to thermal activation, not upon porosity or permeability. Water accompanies ore deposition principally because it is one of the most common thermally unstable compounds in the earth's crust, and thus accompanies the relatively thermally unstable sulphides. Water also increases enormously the rate of metamorphic reaction. The sections which follow discuss in somewhat greater detail the statements that have been made here.

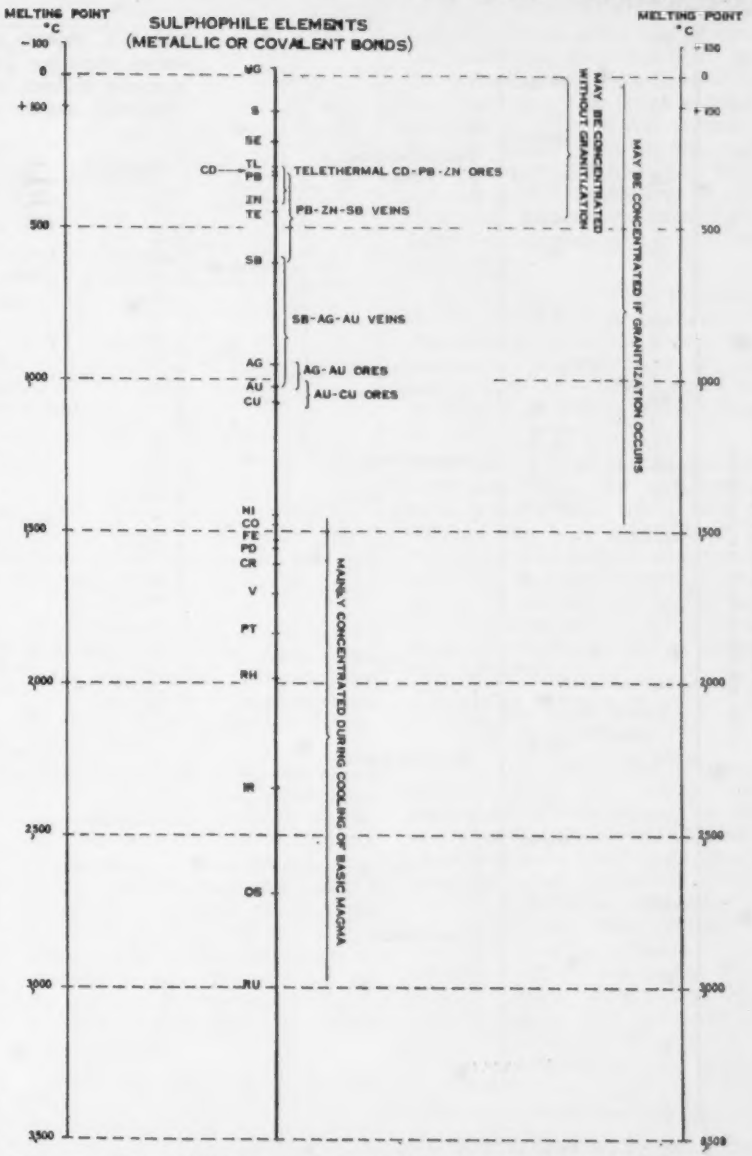


**FIG. 1—RELATIONSHIP** of Metallic Melting Point of Sulphophile Elements to Temperature of Deposition of Sulphides.

### Temperature and Mineral Stability

As shown in Fig. 1, the arrangement of metals according to their melting points corresponds approximately to the temperature arrangement of these metals in ore deposits. The melting point of a metal is not a direct index of the temperature at which that metal, or its compounds, will be mobile in nature. However, for the sulphide-forming metals and for those which are found in native state, the above correlation does exist, pointing to dependence on thermal stability temperatures, not on solubility.

Fyfe, Turner and Verhoogen [3] (pp 25-28) discuss the relationship between mineral stability, temperature and entropy. They state, "The effect of temperature on metamorphic assemblages is that an increase in temperature tends to favor the phase, or assemblage of phases, with the highest entropy." That is, the most stable phase is that which has the highest heat capacity at a given temperature. They show further how the entropy of a solid is related to $\theta$, the Debye temperature, or "characteristic tem-

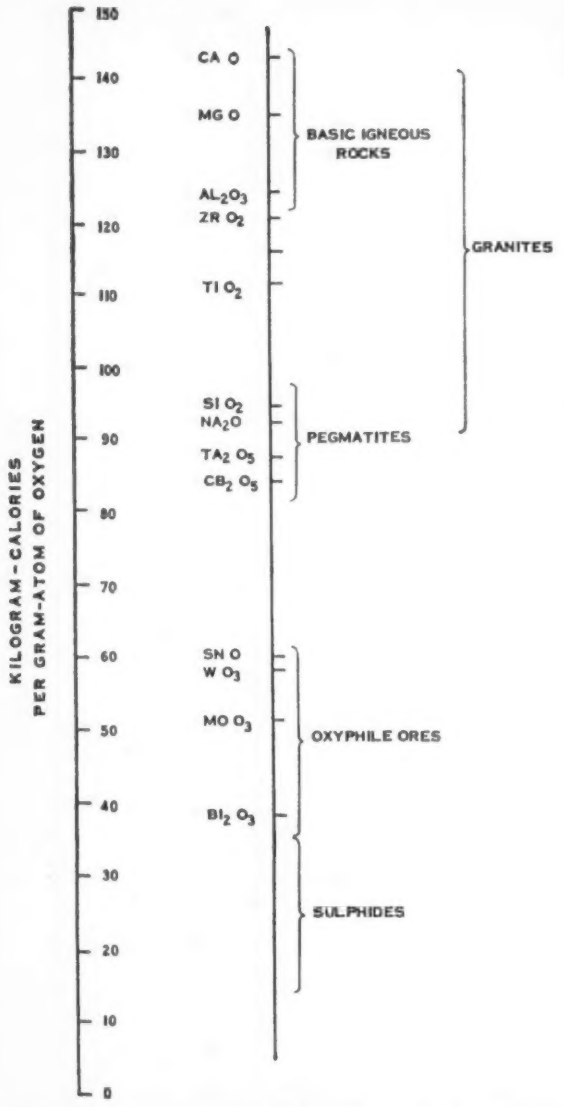


**FIG. 2—HEAT OF FORMATION** of Oxides of Certain Oxyphile Elements. (Data from Rankama and Sahama, 1949)

**TABLE 1. Metals arranged in electromotive force series showing geological significance. Reference is made in each case to occurrence in the primary (thermal) zone.**

Increase in Ionic Bonding ↑

| Element | | Ion | Electrode Potential |
|---|---|---|---|
| Li | Occur as Silicates (Ionic Bonding) | $Li^{+}$ | +2.959 |
| Rb | | $Rb^{+}$ | 2.926 |
| K | | $K^{+}$ | 2.924 |
| Ca | | $Ca^{++}$ | 2.87 |
| Na | | $Na^{+}$ | 2.715 |
| Mg | | $Mg^{++}$ | 2.40 |
| Al | | $Al^{+++}$ | 1.70 |
| Be | | $Be^{++}$ | 1.69 |
| U | Oxide | $U^{++++}$ | 1.40 |
| Mn | Partly Sulphide (Ionic-Covalent Bonding) | $Mn^{++}$ | 1.10 |
| Zn | Occur Principally as Sulphides (Covalent Bonding) | $Zn^{++}$ | 0.762 |
| Fe | | $Fe^{++}$ | 0.441 |
| Cd | | $Cd^{++}$ | 0.401 |
| Co | | $Co^{++}$ | 0.278 |
| Ni | | $Ni^{++}$ | 0.231 |
| Sn? | | $Sn^{++}$ | 0.136 |
| Pb | | $Pb^{++}$ | 0.122 |
| Fe | | $Fe^{+++}$ | 0.045 |
| Sb | | $Sb^{+++}$ | −0.10 |
| Bi | Occur as Native Metals and as Sulphides (Metallic-Covalent Bonding) | $Bi^{+++}$ | −0.226 |
| Cu | | $Cu^{++}$ | −0.344 |
| Cu | | $Cu^{+}$ | −0.470 |
| Ag | | $Ag^{+}$ | −0.797 |
| Hg | | $Hg^{++}$ | −0.799 |
| Pd | Occur as Native Metals (Metallic Bonding) | $Pd^{++}$ | −0.820 |
| Pt | | $Pt^{++++}$ | −0.863 |
| Au | | $Au^{+++}$ | −1.360 |
| Au | | $Au^{+}$ | −1.50 |

perature," at which full or nearly full heat capacity is attained. As discussed in a previous paper, [7] the melting point is a rough indication of the Debye temperature.

These ideas may be illustrated by the case of the familiar mineral, water. At atmospheric pressure, the temperatures 0°C and 100°C are critical: with rising temperature, new heat capacities are attained, and increased mobility and reactivity occur.

The temperatures at which the various minerals found in rocks and ores acquire significant changes of heat capacity are not known to the author; but in Fig. 2 the heats of formation of the oxides of some elements found in rocks and ores have been tabulated. In general, the higher the heat of formation of a substance, the higher is its entropy; also the total heat of formation of a compound may be found, in rough approximation, by adding the heats of formation of the component oxides.

Taking these observations into account, it will be noted that this arrangement of oxides is reminiscent of the temperature sequence in nature. Those oxides with the higher heats of formation are formed at high temperatures. The descending sequence passes through the granitic and pegmatitic phases, thence to oxide ores. The sulphides fall in the low-temperature range, at the base of the sequence. It is important to note that there is no break between the ore-forming and rock-forming processes, such as would be expected if the ores were taken into solution at the end of the pegmatite phase. The observed sequence simply reflects temperature stability ranges.

As shown in Table I, the position of the elements in the electromotive-force series determines whether they will occur as native metals, sulphides, oxides or silicates. The elements with ionic bonding, at the top of the electromotive force series, have high free heats of formation, and form comparatively high-temperature minerals; sulphide-forming metals, and those which occur native, have low free heats of formation, and are unstable at comparatively lower temperatures. The process of ore formation is closely associated with the separation of these two groups of elements.

In the case of an aggregation of sediments which have been subjected to a rise in temperature, at constant pressure, a reaction will proceed in a direction such as to be endothermic; and the result will be a fall in temperature unless further heat is supplied. Crystalline compounds are formed which are stable at the given temperature, and those compounds which are

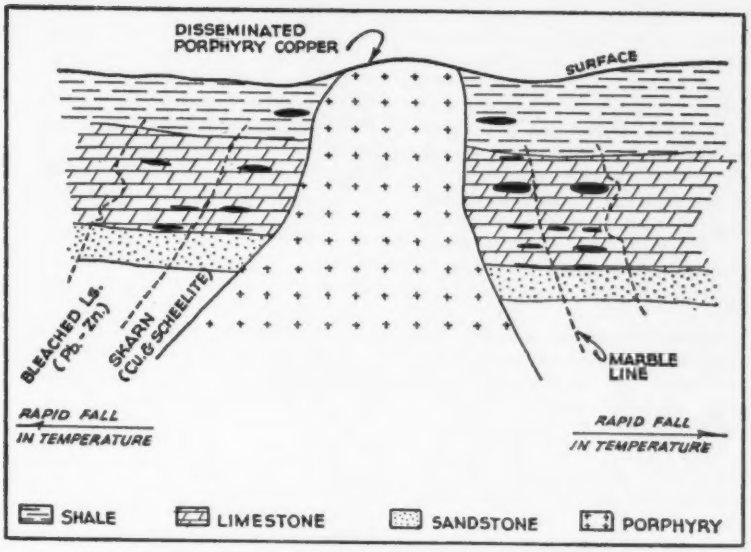


**FIG. 3—PORPHYRY COPPER DEPOSIT:** Diagrammatic Section.

unstable at these temperatures are driven towards the cooler regions. This is similar to the movement of water down the temperature gradient discussed by Fyfe, Turner and Verhoogen [3] (p. 189). The heating process results in the separation of the silicate- and oxide-forming elements, at the top of the electromotive force series, from those which form oxides, sulphides and native metals, found at the bottom of the series.

### Ores Associated With Granitic Stocks

The above process may be illustrated by reference to the diagram of a standard porphyry copper environment (Fig. 3). In this diagram, the porphyry is assumed to cut limestone, sandstone and shale. It is further assumed that the limestone is unmetamorphosed more than a few thousand feet from the stock, indicating the presence of a rapid temperature gradient. Under these conditions, it is common to find disseminated copper sulphides within the porphyry. They are somewhat younger than the porphyry, but only in the sense that they are thermally unstable at temperatures at which quartz and feldspars are stabilized. They were unable to escape from the higher temperature environments of the stock, because temperatures out from the stock were too low to enable these ores to move.

Copper may occur in felspathized quartzite, but is uncommon where the quartzite has undergone metamorphism of a lower grade. Massive replacement ores are rare. This is not because the quartzite is not porous; it is. The replacement ore is found in the somewhat less permeable limestone, and also to a lesser extent in the shale, which is the least permeable of all.

The distribution of deposits among these various formations is due to relative temperatures at which the respective formations may be prepared, by the action of heat, for metasomatism or metamorphism. The lime-rich formation is the most thermally unstable, as is shown by the ease at which it may be metamorphosed; the shale is the next most unstable; and the quartzite, the most stable. This is the order of their relative favorability for replacement.

Within the zone close to the porphyry contact, the high-temperature oxide-forming metals such as tungsten may be found. Copper sulphides may extend throughout the skarn zones, and are thus co-extensive with the metamorphic silicate minerals. Of course copper and tungsten may also occur within the porphyry stock.

Lead and zinc may extend beyond the marble line into the bleached limestone, but not beyond. The metal zoning is co-extensive with the metamorphic zoning, with the most thermally unstable minerals moving towards the cooler rocks; and probably there is a complementary movement of the metals which form the higher temperature silicates towards the hotter zones. If wallrock temperatures are sufficiently high, silica moves into limestone along with the economic metals; and probably, lime moves towards the heat focus where it will form compounds stable at high temperatures. There is no melting of the host sediments, only metasomatism in the solid state. With lower wallrock temperatures, silica, as well as tungsten, molybdenum and copper, may be largely confined to the stock. Lead and zinc sulphides, with lower levels of thermal stability, are usually expelled some distance from the porphyry.

The arrangement of the sulphides, like the arrangement of the metamorphic minerals themselves, reflects the temperature stability range of the various sulphides. It has nothing to do with their respective solubilities in water.

For the same reason that the ore could move into the sedimentary rocks, it could move out of them if sufficient heat were available and if the temperature gradient were favorable. The ores were trapped in the vicinity of the porphyry because the temperature fell below a certain critical point, and reaction and movement were quenched.

### The Shield Versus the Cordilleras

This is the reason that porphyry coppers occur in mountainous regions, where deep erosion has not as yet exposed the widely metamorphosed mountain roots. In the Shield areas, the higher temperature silicate- and oxide-forming elements predominate. By the same token, the ratio of iron sulphide to the sulphides of the elements which are stabilized at comparatively lower temperatures (for example copper, lead and zinc) is higher in the Canadian Shield than it is in both the eastern and the western cordilleras, where regional metamorphism is not so pronounced. Much of the zinc-copper ore in the Shield is associated with post-metamorphic basic igneous rocks.

In New Brunswick, perhaps one in three pyritic bodies contains significant quantities of lead, zinc or copper; in substantial parts of the Shield, this ratio may be more like one in one hundred. Nickel sulphides do occur in basement complexes, as they are fugitive only at relatively high temperatures (Fig. 1); the ores of copper, lead, antimony, zinc, cadmium and mercury are more fugitive, and they are scarce in regions of high-grade metamorphism.

### Hydrothermal Alteration

The presence of hydrothermal alteration around some types of ore deposits has been taken as evidence

that the metals traveled in solution in hot water. Stringham [6] indicates that many of the hydrothermal minerals have a temperature field ranging from 50° to 300° C. Most granite-forming minerals are probably stable by the time the temperatue falls to 450° to 400° C. At these temperatures, neither the hydrothermal minerals mentioned above nor the sulphide-forming elements are fixed in stable compounds, and they tend to collect together after the main mass of granite has stabilized. Their association, like the association of lead and zinc sulphides, depends on their common thermal stability ranges.

Water is abundant in sediments, and is also commonly expelled from volcanoes. Its presence in a mobile form around heat foci is to be expected; and the association of hydrothermal alteration with sulphide ores does not indicate that the ores were in solution in the water.

### Function of Dikes

Since sulphides have minimum critical temperatures below which they cannot move, the presence of planes of hot rocks, such as dike-filled faults, facilitates their movement. It is common to find cobalt-copper and cobalt-silver ores adjacent to basic dikes and sills—also zinc-copper ores in a massive pyritic gangue. Characteristically, these ores occur immediately adjacent to the dikes, because the surrounding rock was not sufficiently heated for them to move far. The dikes are not, in all probability, the source of the ore, but the sulphides have been able to diffuse through them. It seems probable that these dikes may tap larger bodies of hot rock below.

### Structure

It was thought for many years that all ore came from great depths, and the fact that many deposits are localized in faults and shears appeared to support this view. There is no doubt that such structures are favorable for the occurrence of sulphide deposits; but in the case of ores distilled from sediments or other rocks,* they are no more important than the structures which localize oil in an oil province. Without source rocks and the mechanism of concentration, there would be no metalliferous provinces, irrespective of the structures present.

Sheared zones are susceptible to replacement by albite and other granitic porphyries, for example, in the same way that they are susceptible to replacement by sulphides. However, no one has suggested that the granitic material was brought in as a solution, although this has generally been assumed in the case of sulphide ores. During the shearing of rock, the high energy crystals are destroyed and are replaced by laminated rock. Diffusion or other movement of ions through a crystal is difficult, and normally takes place along grain boundaries. Shearing thus facilitates movement.

Additionally, it is probable that sheared rock is more readily thermally activated for replacement by invading metallic particles than is crystalline rock. A sheared rock is favorable in the sense that it may more readily be metamorphosed and metasomatized than unsheared rock.

### Volcanoes

Some might gather from the above discussion that the author thinks that all ore deposits are concentrated from sedimentary rocks by metamorphic or other processes. On the contrary, it is clear that many major sulphide ores, massive and otherwise, are associated with volcanic vents, explosion breccias and other evidences of deep-seated igneous activity. Some ores associated with basic dikes could be considered as having volcanic associations.

Again, however, this appears to the writer to represent a normal separation of the comparatively thermally stable silicate phase from the sulphide and hydrous minerals which stabilize at lower temperatures. As a large body of rock containing ore-forming metals, sulphur and water is heated, these substances are dricen off in a normal distillation process. They deposit where temperatures fall to a point at which they again become stable solids.

### Conclusion

To test the above suggestions, it is necessary to determine experimentally the critical temperatures at which the various ore-forming minerals attain significantly different heat capacities, and likewise, it is suggested, become reactive and mobile. There is evidence [3] that the presence of a catalyst, such as water, may greatly facilitate such reaction and movement.

### Acknowledgment

My thanks are due to Mrs. M. G. McCamus for considerable assistance in the preparation of this paper.

* Structure is somewhat more fundamental where ores come from great depth, as at volcanic foci.

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**For the reader's convenience,** here is an index of geological, geophysical and geochemical articles that have appeared in E&MJ's guidebooks, 1955-60.

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Two planes speed EM work . . . . 1959 : 207

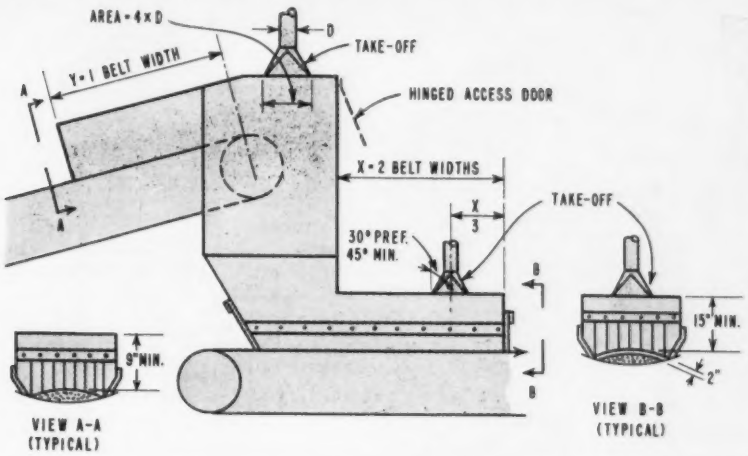



**FIG. 1** Two take-offs, one at top belt hood and one at bottom belt hood, provide better dust control with less pickup than single exhaust in belt-to-belt transfer.

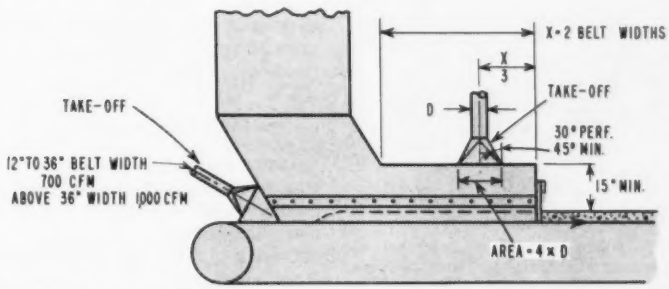



**FIG. 2** Small take-off should be placed where belt enters dump point on chute-to-belt transfer because dust may escape when belt is deflected by falling material.

# How To Select Ductwork, Hoods and Dust Collectors

**HENNING E. SODERBERG**

Mr. Soderberg is supervising engineer for the American Air Filter Co. Inc., Louisville, Ky.

THERE IS COSIDERABLY MORE TO an effective dust control system than the collection of dust generated by a process. Just as a processing plant is dependent on many factors for a quality finished product, a good dust collection system is a matter of well-designed components.

The three components of a dust control system are hoods, dust collectors and connecting ductwork between the hoods and the dust collectors. Failure of any of the three because of poor design, deviation from accepted dust control standards or improper dust collector selection, will result in a poor or inoperative dust control system. Certain basic fundamentals for each component will be discussed in detail. It is assumed that the air volume and points of exhaust have been determined and are correct. The following information is from the point of view that the problems and application in the mining industry are more severe than other industries.

## Hoods

Falling material will induce air to flow in the same direction as the material. This induced air is called entrained air, with the amount depending mainly upon the height of the fall, type of material, enclosed or open chute, size of rock and amount of material. Hoods or enclosures are required to confine the dusty air resulting from falling and moving material.

The hood is that part of a dust control system enclosing a dust producing operation. It can vary in size and shape, depending upon the application involved, such as belt conveyor to belt conveyor, crusher or screen exhaust, bin ventilation and others. It is that portion of the dust control system where the dust-laden air first enters the system.

Air exhausted from the hood should be sufficient to provide a slight indraft through all the normal openings at all times during any phase of operation. The hood, where possible, should provide an ample plenum effect to assist in taking care of surges of air resulting from irregular flow of material as well as allow the heavier dust particles to settle out. The point of take-off from the hood should be as far as possible from the point of maximum dust generation in order to reduce the amount of dust picked up and thereby reduce wear to ductwork and collectors.

Some designs should have provisions for access into the hood, primarily for operating personnel to periodically check the flow of material. Doors should be hinged and should be so designed that they must be held open when making periodic inspection and will close by their own weight. On all hood enclosures for conveyor belts, a flexible flap is installed on both the entering and leaving ends of the hood. Where a belt enters a hood, the flexible flap should be cut to the contour of the material, but no additional clearance need be required as the flap will be deflected into the hood by the flow of material. However, on the leaving side, the flap should be cut to allow approximately two in. of clearance between the contour of the material and the flap. This eliminates the possibility of the flexible flap coming in contact with the material and causing regeneration of dust. The dust would not be pulled into the hood enclosure because of the action of the belt and material moving away from the hood. All take-offs, where possible, should be tapered from the belt centerline and the area of the take-off in the hood should be at least four times the duct area.

To further evaluate hoods it is necessary to describe certain types.

**Belt-to-belt transfer.** Some designers propose only one point of exhaust between the top and the bottom belt with the point of take-off nearer the

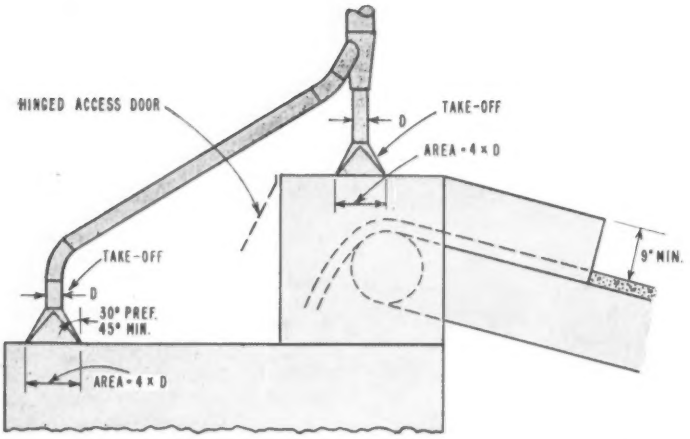



**FIG. 3** Bins are ventilated from top with take-off remote from point of dust generation. Take-off should be tapered, with open area of bin four times duct area.

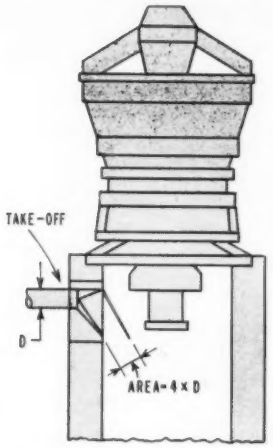



**FIG. 4** Side take-off on crusher slopes toward bottom and is shielded at top.

bottom belt. They rely on the falling material to cause an indraft into the top hood. It has been the writer's experience that two take-offs, one at the top belt hood and one at the bottom belt hood, provide better dust control with less pickup than a single point exhaust. (Fig. 1)

**Chute-to-belt transfer.** Where material falls from a chute to a belt, an extremely dusty condition can exist because of entrained air with the falling material. It was stated at the beginning of the article that all points of exhaust were assumed correct; however, one point of exhaust is normally omitted. In addition to the conventional take-off on the leaving side of the belt, a smaller take-off should be provided where the belt enters the dump point as dust can escape due to deflection of the belt from the falling material. The air volume required is relatively small but it results in successful dust control. (Fig. 2)

**Hopper, bin and chute ventilation.** Normally bins are ventilated from the top with take-off as far away from the point of dust generation as possible. The take-off should be tapered with the open area of the bin at least four times the duct area. (Fig. 3)

Use a side take-off on hoppers or chutes, such as underneath crushers, when they are exhausted. The take-off should be designed so that all the slope is on the bottom. A shield placed on the inside of the hopper will prevent material from getting into the duct system. If the hopper should fill up and plug this take-off, it would clean itself when the material receded. (Fig. 4 & 5)

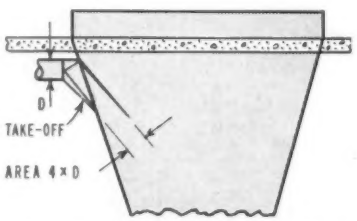



**FIG. 5** Sloped take-off on bin vent allows receding material to clean opening.

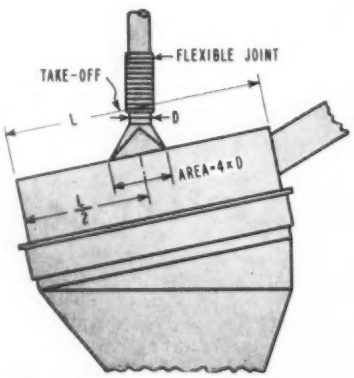



**FIG. 6** Dust should be exhausted from a hood fastened to the top of a screen.

**Screens exhaust.** The exhaust should always be from the top with a hood preferably attached to the screen. (Fig. 6) Exhausting from underneath without a hood on the screen will result in extremely high dust loads with no control where the material hits the screen. Even if there is a hood available, hopper exhaust does not prove satisfactory, as it is possible for a screen to become blinded momentarily with surges of material. This same type of reasoning also applies to exhaust of crushers. It is impossible to provide proper dust control for a crusher feed by attempting to exhaust from underneath the crusher.

## Ductwork

Ductwork is that portion of a dust control system between the hood or pick-up point and the collector. Normal duct velocity for mining applications is 3,500 fpm, with variations from 3,200 to 3,750 fpm permissible. There are two basic concepts of dust control design: one in which blast gates are used in the individual branches to regulate air volume; and the other in which no blast gates are used. Instead the duct system is designed so that the resistance in each of the branches is equal to the resistance at the point where it connects into the main duct. The second method, or balanced system, is not recommended for mining applications because of less flexibility, irregular pipe sizes and higher duct velocity in some branches that will lead to excessive abrasion. The blast gates design has proven to be the most practical in mining.

Entry of branches into the main duct should be from the side or from the top. (Fig. 7) The transition of entry should be such that the area increases correspondingly with the increase in air volume allowing constant duct velocity. Resistance and abrasion are reduced by having a more streamlined air flow and reduced turbulence—important factors to consider when designing a good dust control system.

Closing the damper on a blast gate design system results in less open area of the duct which causes air velocity to increase in that portion of the duct. The result is added resistance. The

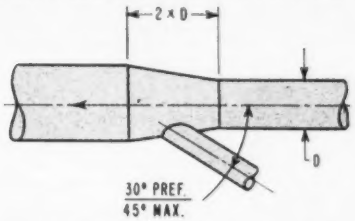



**FIG. 7** Entry of branches into the main duct should be from the side or the top.

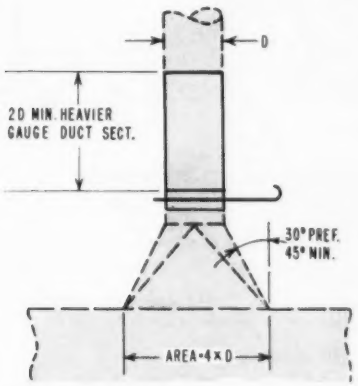



**FIG. 8** Highly successful slide blast gate is recommended for mining industry.

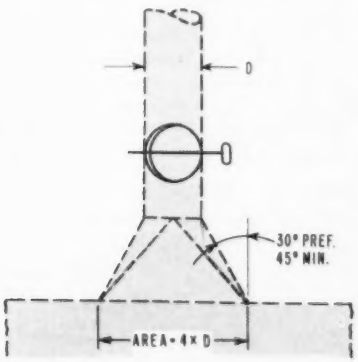



**FIG. 9** Butterfly-type damper, subject to heavy abrasion, is not recommended.

duct section following the damper should be thicker to prevent turbulence that causes abrasion. Blast gates are used to change air volume requirements after the system is placed in operation. Variation in material flow or fineness of material and slight changes in the initial design of air volume values are adjusted by blast gates.

The recommended type of blast gate is the slide gate. (Fig. 8) After the system is properly balanced it should be bolted or tack-welded in place to eliminate any possibility of change by plant personnel. This is the most widely used type and has proved highly successful. The butterfly

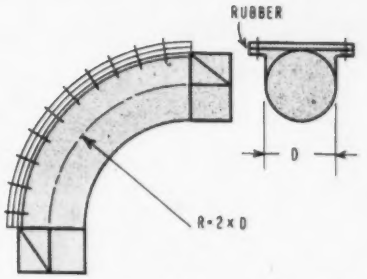



**FIG. 10** Removable outer periphery increases life of the rubber-backed elbow.

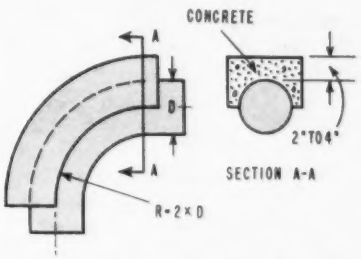



**FIG. 11** This elbow lasts longer because of concrete cast in the outer periphery.

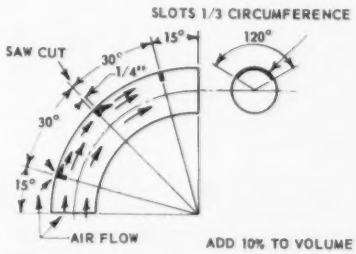



**FIG. 12** Air entering slots in a regular elbow stop perimeter dust impingement.

damper type (Fig. 9) is definitely not recommended on mining applications because the damper is completely in the airstream and subject to more abrasive action. It is also difficult to determine the exact position of the damper because of possible slippage of the damper on the shaft. Replacement of this damper is also a problem after ductwork has been completed. The slide type of blast gate requires only the removal of the bolt or tack-weld for replacement. Because dust is abrasive, it is recommended that all duct sections be flanged. This will permit their removal from the system if required. A gasket is required between each flange joint to eliminate detrimental air leakage. Thickness of the material for ducts can vary, depending primarily on the nature of the material handled. A thickness of 10 gage has been used on several taconite jobs; but with a properly designed dust control system, ductwork constructed

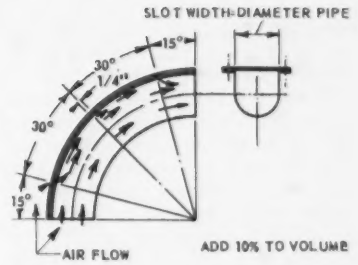



**FIG. 13** A flat side elbow with slots is successfully used in foundry industry.

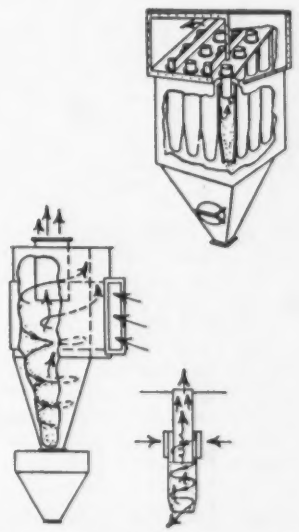


**FIG. 14** The dry centrifugal collector is used where the dust loading is light.

of several gages lighter is sufficient.

There are times when attempts are made to reduce air volume requirements on parallel conveyor-belt systems, where only one of the two conveyor belts is operated at any one time. The damper is closed in the branch to the non-operating belt and opened in the other branch. This looks good in theory but not in practice because dampers may become inoperative and operating personnel may fail to open the proper damper. This method of dust control should not be used.

On dust control jobs in mining, the elbows will show the most wear. This is due to the action of the air turning in the elbow, causing the dust to be moved to the outside by centrifugal force. Standard design recommends a minimum inside radius of 1½ duct diameters. Two duct diameters are preferred if space requirements permit. The larger the radius, the less wear there will be; however, the inside radius of 1½ duct diameters has proven satisfactory on most jobs. On some jobs, such as taconite applica-

tions, other designs had to be employed to give a practical life on elbows. Experiments were first tried on different types of metal for elbow construction but the tests indicated little or no increase in life. Considerable success has been obtained, however, with two types of elbows: one design uses a rubber-backed elbow in which the outer periphery is removable (Fig. 10); the other is a concrete elbow (Fig. 11) incorporating a thickness of from 2 to 4 in. of concrete that is cast in the outer periphery.

Another approach on an abrasive-resistant elbow design incorporates the use of slots. (Fig. 12 & 13) Air entering the slots deflects the dust which normally would impinge against the outer perimeter of the elbow. This has been tried in the last few years in the foundry industry with success.

The duct system should be adequately supported with cleanouts provided along its length, so that it can be cleaned with a minimum of trouble in case it becomes completely filled. The use of round ducts is more or less standard for dust control application. On occasion, rectangular ducts have been used, but the resistance is slightly higher per length of run than round ducts.

## Dust Collector Selection

A number of different types of duct collectors are available on the market, both dry and wet, which are designed to handle processed dust from the mining industry. The selection of the particular type of dust-collecting equipment should be determined by some of the following points:

**Quantity of dust expected.** Some dust collectors are not designed for heavy dust loadings and extreme care should be taken when considering such equipment on heavy duty applications, both from life of equipment and efficiency performance desired.

**Fineness of dust handled.** The smaller the dust particle, the harder it is to collect, whether wet or dry equipment is used. Select equipment to give efficiency and performance

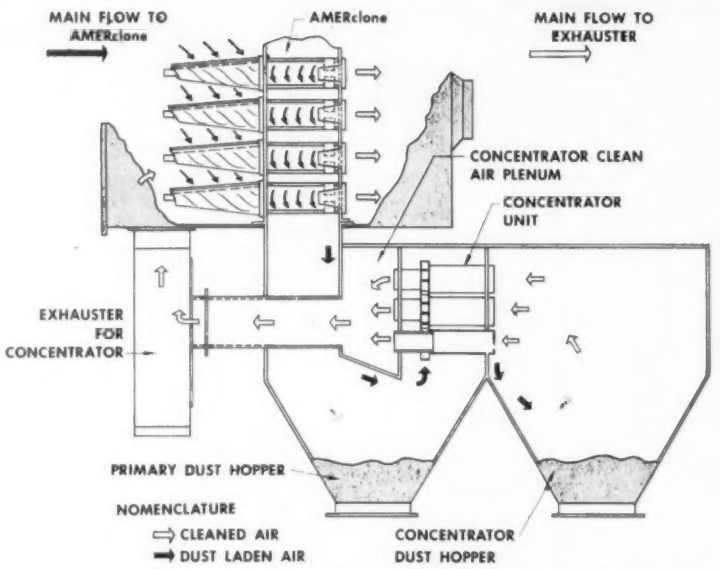



**FIG. 15** Low efficiency and heavy visible discharge make the dry centrifugal collector unsuitable for most mining applications. Operational life is 1½ yr.

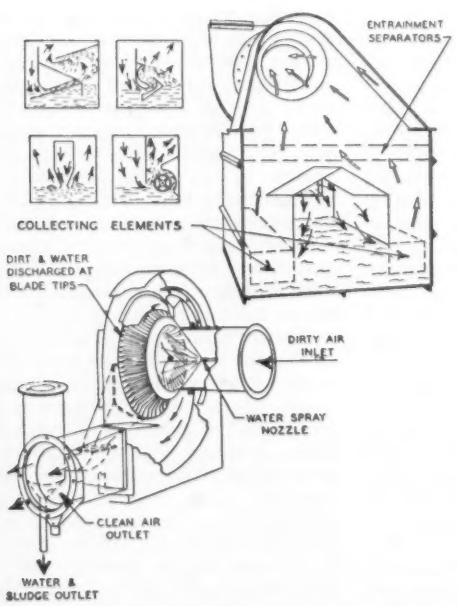



**FIG. 16** Orifice-type collector (top) employs circulating water bath while wet dynamic centrifugal type uses sprays.

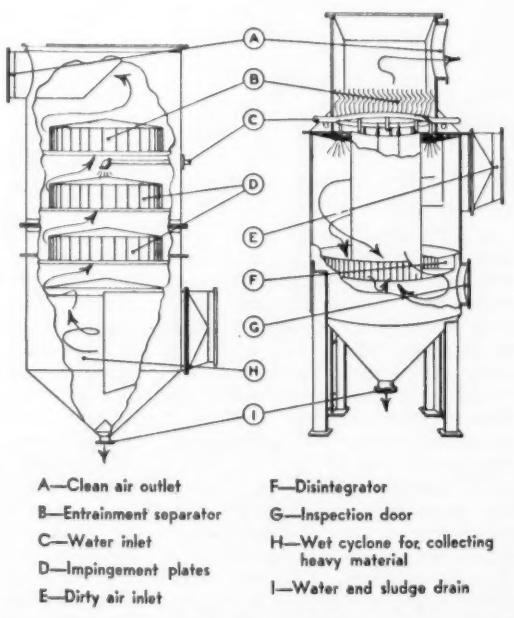



**FIG. 17** Wet collectors have an efficiency in the 98% to 99% plus range down to particles about one to two microns in size.

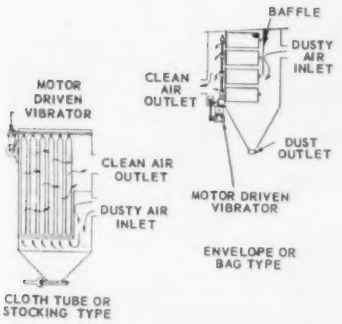



**FIG. 18** Cloth collectors provide a solution where no space limitation exists.

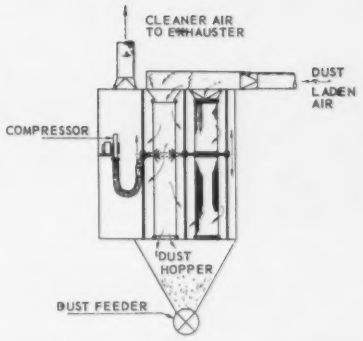



**FIG. 19** New reverse jet type, using moving blow ring, has met with some success.

desired on basis of particle size of dust.

**Space that is available.** Where small space is available for dust collector location, only those collectors fitting the space requirements can be evaluated and final selection made.

**Method of dust recovery.** Selection of wet or dry collection equipment depends upon the type of dust recovery in flow process.

**Collector location relative to freezing.** This applies only to wet collectors and collectors handling moist air. Re-evaluate the design if no heat is available or if condensation is possible.

**Degree of cleaning efficiency.** With the enactment of new air pollution codes and the increasing requirements of others, this item probably is the most important in equipment selection. If there is a maximum allowable limit of dust in the discharge stack as expressed in grains per cubic foot or pounds per minute, state this in specifications.

**Condensation.** If there is a possibility of condensation of humid air in a dust collector, provide proper equipment location or that type of collector design, such as wet collector, where little or no troubles will result.

The three general types of collectors most accepted are high efficiency dry centrifugal collectors, wet collectors and cloth collectors.

High efficiency dry centrifugal collectors have wide acceptance and fair efficiency with a pressure drop in the 4 to 5 in. range. Its efficiency will tend to fall off fairly rapidly on particles less than 10 microns. It is because of this lower efficiency and heavy visible discharge that it is not too acceptable for mining applications. Less than designed air volume on collector also results in decreased efficiency. Collected material can be a secondary dust problem unless care is taken in the design. Collector life is at least 1½ years of continuous operation with constant resistance and air volume.

The dry centrifugal collector is used generally on dust control systems where dust loading is very light, where the system is run inter-frequently, where it is located in a remote or unheated area or where there is dilution (very low dust loading that results from part of the system being exhausted or not in operation). (Fig. 14 & 15)

The wet collector category consists of the wet dynamic centrifugal collectors, or tower type, which use water sprays, and the orifice type collectors that employ a recirculating bath of water. Efficiency on mining application jobs is in the 98% to 99% plus range. Constant efficiency is maintained with no change generally with variation in air volume. There is little or no abrasion. This type of collector provides a high degree of efficiency down to about one to two microns in particle size, and will provide most mining jobs either an invisible or slightly visible discharge appearance. For those mining jobs using a wet processing circuit, this type of collector is recommended, as all material can be returned to the process continuously with no secondary dust problems. This type of equipment will generally handle the highest dust loads with the least amount of maintenance and replacement parts. (Fig. 16 & 17)

Cloth collectors have long been used in the mining industry and provide a satisfactory solution where there is no space limitation. The efficiency is 99% plus with expected life on cloth media from one to three years. The type of cloth collector most generally used is the shaking type where a portion of the collector is removed from the line and vibrated. In the last few years the reverse jet type, using a moving blow ring, has been tried with limited success. (Fig. 18 & 19)

Handling the collected dry material can be a secondary dust problem, much the same as with a dry centrifugal. All cloth collectors are subject to some variation in air volume with the reverse jet type providing nearly constant operating resistance.

Moisture and condensation are very detrimental to cloth collector operation and they should not be used unless provisions have been provided in the design of the system.

## Coming Next—An Industry Application

IN THE NOVEMBER 1958 issue of E&MJ, David H. Wheeler of Kaiser Engineers issued the following statement:

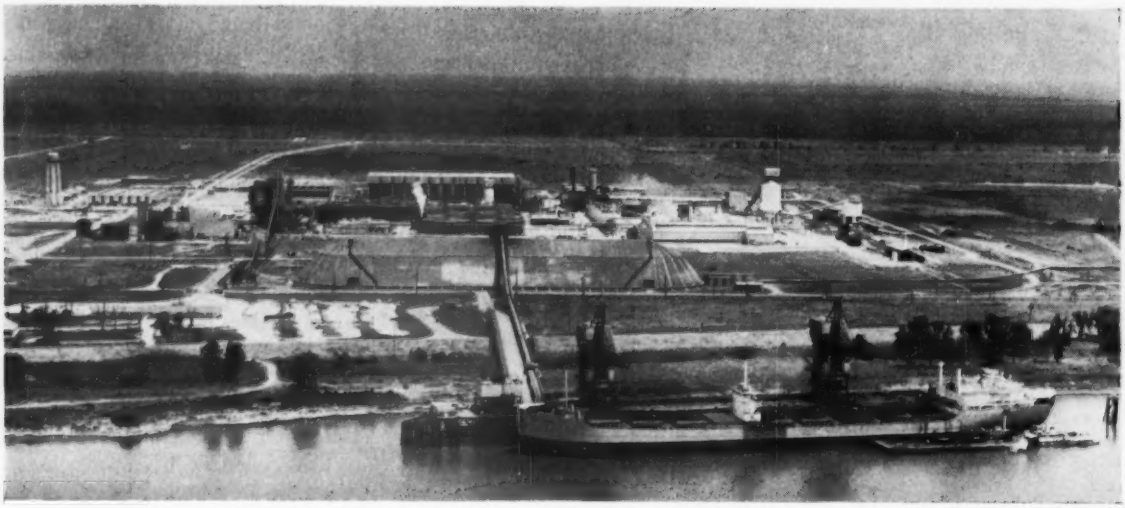
"The importance of air pollution control and materials recovery in present day planning is evidence by the great interest of the public and various government agencies, in addition to industrial management and engineering staffs. Recently it was reported that industries are spending $300-million a year on air pollution equipment.

"Objective planning in air pollution control and materials recovery achieves the most effective, economical solution. In existing plants, this involves complete surveys and studies of applicability of control methods and equipment, plant location and meteorological conditions.

"In new plants, the primary factors are the selection of plant location, process and control equipment — all based on use of data from similar processes and equipment.

"An independent engineering organization can be valuable in planning air pollution control programs because of broad experience in many industries and processes and with many types of equipment."

In the following pages, Mr. Wheeler and his colleague, J. V. Day, tell how planning and implementation have achieved effective air pollution control at Kaiser's Gramercy Works.



**NEW PLANT** refines Jamaican bauxite into alumina by the Bayer process. An air pollution control program was adopted early in the planning stage, and efficient control systems were installed at each potential source of air pollutants.

# Planned Program Achieves Effective

**D. H. WHEELER**

**J. V. DAY**

**1. Factors to be evaluated in establishing a program and in designing control systems.**

**2. Description of the air pollution control systems at the alumina plant designed and built by Kaiser Engineers for Kaiser Aluminum & Chemical Corp., Gramercy, La.**

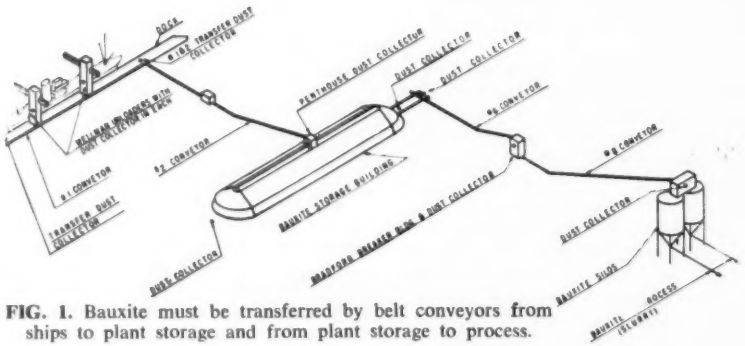



**FIG. 1.** Bauxite must be transferred by belt conveyors from ships to plant storage and from plant storage to process.

AS THEORISTS, air pollution control engineers would like to achieve 100% control—complete elimination of gas, mist, fume and dust emissions that might be classified as "unwanted material" in the atmosphere. However, 100% control is not possible, so a program must be established to meet the following requirements:

1. "Good-Neighbor Policy" or control ordinances.
2. "In-plant" industrial ventilation.
3. Recovery of valuable material.
4. Clean gas for use in process or combustion.

Planning an air pollution control program to achieve these requirements calls for evaluation and integration of many factors. Design of individual control systems in a plant must conform with the over-all program requirement, and the details of each system need close attention. In developing a program and the specific design details, close coordination is required between planning and design engineers and process or production engineers.

Major factors which must be evaluated in establishing an air pollution control program include plant location, types and sources of pollutants and methods of control.

Meteorological conditions, such as wind direction and velocity patterns, plus frequency and duration of inversion or fumigation conditions, are prime factors in determining atmospheric dispersion of pollutants emitted from a plant. Likewise, localized conditions that produce wind turbulence may also affect ground concentrations.

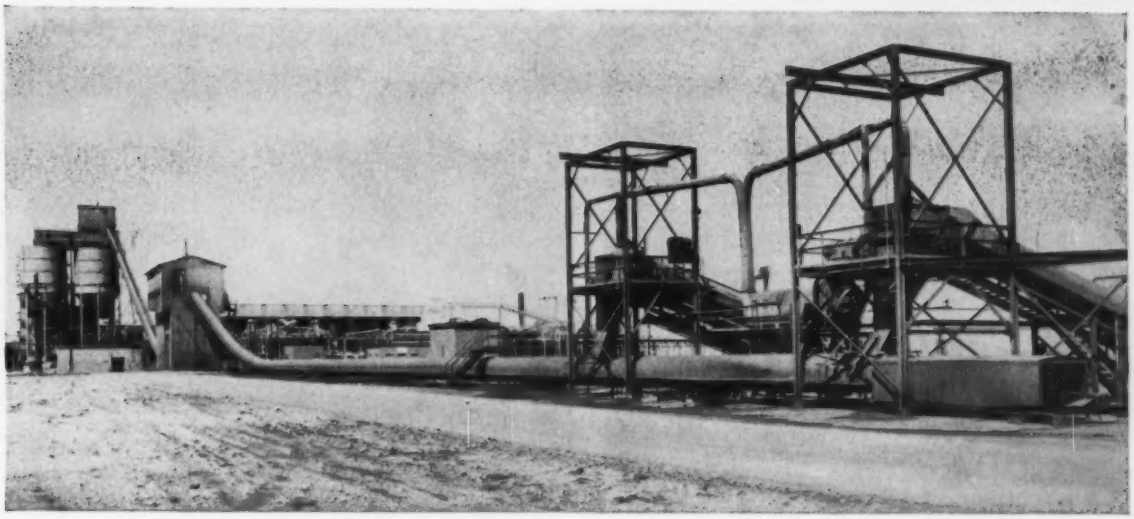
Geographical conditions of the area surrounding a plant also are important in determining the air pollution control program that should be adopted. A plant located in a broad valley will undoubtedly experience much different stack plume dispersal characteristics than one on a coastal plain or in a narrow valley in hilly or mountainous country.

Location of residential areas, light or heavy industrial areas, agricultural areas and the type of crops produced also are of vital importance in planning the control requirements. Further, every program should provide for future environmental changes.

Air pollution control regulations or

Mr. Wheeler is principal engineer on air pollution control for Kaiser Engineers. Mr. Day is technical superintendent at the Gramercy alumina plant of Kaiser Aluminum & Chemical Corp., where he works on technical process problems.

Factors to be evaluated



**ALL CONVEYOR BELTS** located outside buildings are equipped with metal housings for rain protection which also prevents entrainment of dust by winds. Eight complete collecting systems control dust emission from the bauxite conveyors.

# Air Pollution Control at Gramercy

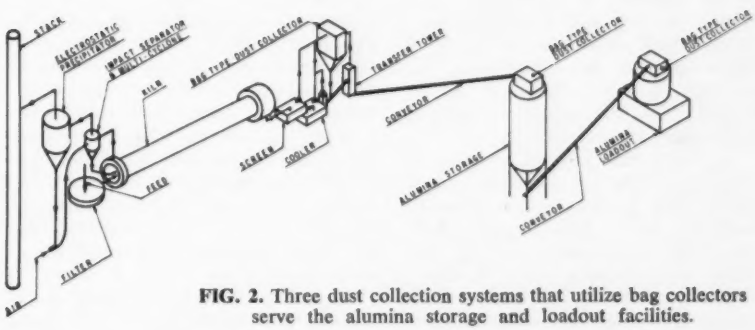



**FIG. 2.** Three dust collection systems that utilize bag collectors serve the alumina storage and loadout facilities.

industrial zoning ordinances, if applicable to the plant location, dictate minimum control requirements. Engineers must utilize "crystal ball" engineering in providing for the possibility of future regulations or changes in the existing regulations.

## Types and Sources of Potential Pollutants

There are four principal types of pollutants: dust, gas, fume (very small condensed particulates) and mist (liquid droplets). The physical and chemical characteristics and the sources of the pollutants are basic factors in planning a program and in designing control systems.

Pollutants generally originate in either of two sources: mechanical, or metallurgical-chemical processes. Mechanical processes include conveying, elevating, crushing, grinding, screening, cooling, storage and packaging. Dust is normally the only type of pollutant produced by these processes. Metallurgical and chemical processes, such as calcining, sintering, roasting, combustion, electrochemical and chemical reactions may produce various types of pollutants. In addition, some processes such as calcining kilns often emit fumes and dust, and some calcining operations may also emit gas, such as sulphur dioxide.

## Methods of Control

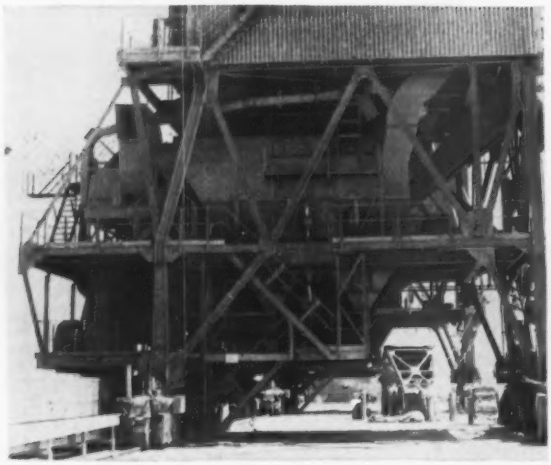
After the air pollution control engineer considers the factors of plant location, and the type, characteristics and source of pollutants, he must determine which method will provide the required control. The method selected will be greatly influenced by the efficiency required, capital costs, operating costs and operating characteristics, in addition to other factors mentioned elsewhere.

The most desirable method of air pollution control is at the source—for example: complete combustion in a furnace to eliminate black smoke. Also, process changes or modifications may provide control at the source or greatly reduce the emission of potential pollutants.

However, control at the source is not possible in most installations. A system, therefore, must be designed to contain and collect the pollutants and to handle the gas and the collected material. Many components—hoods, ducts, collectors, fans, stacks and material handling equipment — are required in the average control system. The components are all equally important.

The five basic types of collectors are inertial, cyclonic, filters, scrubbers and electrostatic precipitators. Many variations of each type are available today, and new equipment is being introduced frequently. Each has advantages and disadvantages so that the proper type and model must be selected to suit the particular need. For some systems it is advantageous to utilize two or more collectors in series.

Engineers should consider the possibility of utilizing chemical reactions



**EACH GANTRY CRANE** includes a dust collection system consisting of 2 scrubbers, 2 exhaust fans and a water pump.

**COLLECTORS** on each side of the bauxite storage building provide tunnel ventilation and traveling-feeder dust control.

to convert pollutants to non-pollutants or to a form that could be collected more readily. Some pollutants may be removed from a gas stream by absorption or adsorption processes.

Determining the most feasible stack height is also very important. Under certain meteorological and geographical conditions a tall stack will provide effective and harmless atmospheric dispersion of pollutants that are difficult to remove from the gas stream.

## Design

Following adoption of an over-all program and selection of basic equipment, each potential source of pollution must receive detail attention in design. Ingenuity may be required to adapt general requirements to meet specific situations. Whatever the system, it must be designed to minimize interference with operation and maintenance of process or material handling equipment.

Components should be selected for particular conditions, because the source of pollutants, type of collector or method of handling collected material affects their operation. Good design details are the ultimate requirement for effective and efficient control systems.

The following examples illustrate the importance of design details in a control system for material handling:

1. Hoods must be designed to contain and capture dust that might escape, but not entrain excess materials due to high internal velocities in the hood. The design must also provide access for equipment inspection and maintenance.

2. Duct location and sizing are critical in order to obtain a balanced flow in the system and avoid dust deposits in duct sections. Short duct runs are preferable, and inspection-cleanout openings should be provided in all inclined or horizontal runs. Where "sticky" dust is handled, horizontal runs should be avoided. If layout dictates horizontal runs, the velocity in those ducts should be higher than in vertical or inclined ducts located upstream.

3. Individual control systems in each local area are sometimes much better than central systems covering extended areas. This is particularly important in systems handling dust which has a tendency to clog the ducts.

4. Dust handling systems must be designed to avoid dust re-entrainment in the atmosphere or minimize dust recirculation in the control system.

## Air Pollution Control Systems at Gramercy

A new plant at Gramercy, La., to refine Jamaican bauxite into alumina by the Bayer Process was placed in operation last year by the Kaiser Aluminum & Chemical Corp. A caustic chlorine plant was also installed at the plant site.

An air pollution control program was adopted early in the planning stage for the plant, and efficient control systems were installed at each potential source of air pollutants. The plant aptly illustrates an air pollution control program and design of air pollution control systems, as there are several types of dust and processes involved. All major types of dust collectors are also included among the various control system components.

Gramercy, midway between Baton Rouge and New Orleans, is a community of 4,000, located one mile east of the plant site. Annual rainfall is about 65 in., with prevailing southeast winds averaging 8 mph and the maximum seldom exceeding 20 mph.

Although there are no air pollution regulations in Louisiana, it has been the policy of Kaiser Aluminum to be a good neighbor and build plants that meet the strictest requirements. The basic program adopted for the Gramercy Works was to insure that air pollution be minimized and that the equipment operate satisfactorily on a continuous basis.

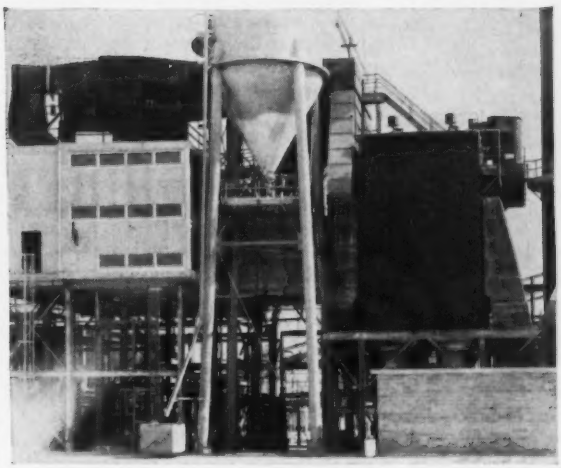
A number of materials handled at the Gramercy Works can produce dust. Among the raw materials are bauxite, from which alumina is extracted, and lime and starch, which are used in the process. The final product, alumina, is a finely divided powder also capable of producing dust. The plant site also has facilities for producing chlorine and caustic soda, using electrolytic diaphragm cells. All chlorine is removed from air stream being released to the atmosphere from the process.

## Bauxite Control Systems

Handling bauxite is one of the main potential sources of air pollution at Gramercy, because it must be unloaded from ocean-going vessels, transferred by belt conveyors to plant storage and from plant storage to process.

The Jamaican bauxite used is a finely divided red ore containing

## Description of Gramercy systems



**GAS** from each alumina kiln passes through an inertial separator and multi-cyclone (top left) and precipitator (right).

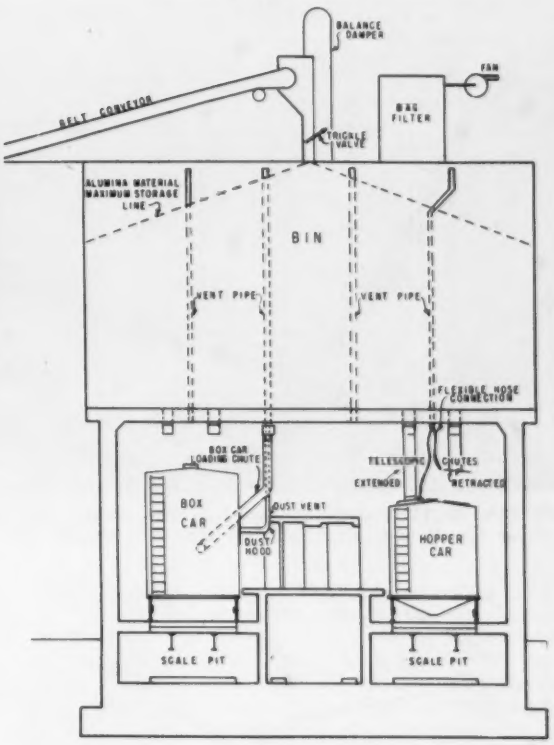



**FIG. 3.** System at alumina loadout station provides ventilation for the hood over the belt conveyor and from each of 30 chutes.

about 45% total available alumina. Bauxite containing more than 18-20% moisture by weight is sticky and difficult to handle on belt conveyors and in hoppers and transfer chutes. Therefore, it is dried to about 16% moisture content before it is loaded into ships. The finely divided dry bauxite produces dust readily, and the red color makes it particularly objectionable.

Airborne bauxite dust picks up moisture easily. It can plug air ducts and will quickly blind the cloth in bag filters. Further complicating the design problem, conventional wet scrubbing equipment may allow the bauxite to build up at the junction between dry ductwork and the wetted parts of the scrubber. After extensive tests at the Baton Rouge Works of Kaiser Aluminum, a horizontal cyclonic type scrubber was selected for Gramercy. At the Baton Rouge plant, this equipment was relatively free of plugging while providing good recovery of dust from the feed to the scrubber. Horizontal cyclonic scrubbers are used in all control systems on bauxite handling equipment.

The gantry cranes located on the dock are each equipped with 10 cu yd clam-shell buckets to unload ships, a surge hopper, and a feeder to deliver bauxite from the hopper to the dock belt conveyor. Although complete elimination of dust from this unloading operation has not been possible, design of the gantry cranes has cut it to a minimum. The main source of dust loss in this operation occurs when ore is being lifted by clam-shell buckets from the hold of the ship to the transfer hopper. It is considered that the gantry cranes used in this operation are the most completely dust-free units of this type in industry today.

To achieve effective dust collection, each crane includes a complete integral dust collection system of 72,000 cfm capacity with two cyclonic type scrubbers, two exhaust fans and a water pump to supply water to the scrubbers. Water required for the scrubber is picked up by pump from a water trough extending the length of the crane travel. The area above the crane hopper is completely enclosed, except for an opening required for passage of the crane bucket. Slot type manifold hoods extend along both sides of the opening for the crane bucket to provide a dust capture velocity in the opening and neutralize air currents induced by the fast moving crane bucket or by strong winds.

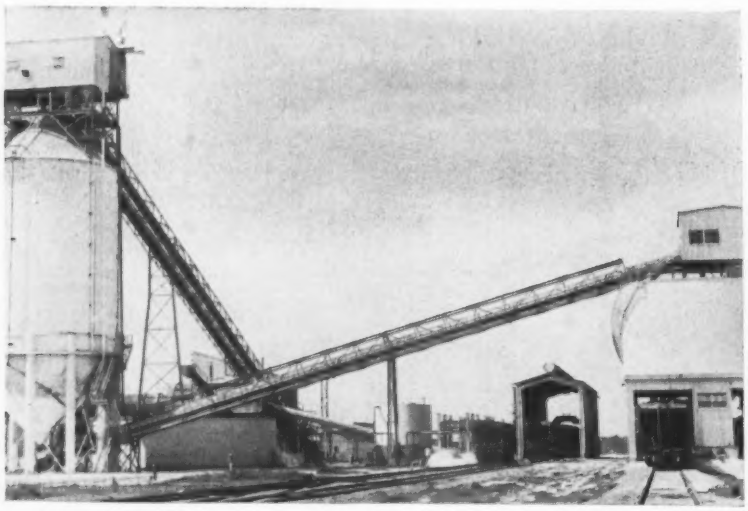
The conveyor on the dock is enclosed with metal sheeting on both sides and has a flexible belt cover which is lifted by rollers enclosed in a hood on the crane and replaced as the crane moves along its track. The cover is specially reinforced and cambered to make it air- and dust-tight. Bauxite is then transferred by covered-belt conveyor to storage, with a dust collector at each of two transfer points.

Two bauxite storage building reclaim conveyors are installed in parallel tunnels, each 900 ft long. A collector is located at each end of the storage building. The systems are designed to provide ventilation for the tunnels in addition to dust control on the traveling feeder. The ducts from each collector extend halfway through each tunnel, and all tunnel ventilating air enters the ductwork at mid-point of the tunnel. In addition, each duct is fitted with connection for feeder ventilation at each storage reclaim gate. These connections are closed except when the feeder is located at the associated reclaim gate.

All conveyor belts located outside buildings are equipped with metal housings for rain protection and also to prevent entrainment of dust by winds. Hoods are installed at all loading, discharge and transfer points and eight complete collecting systems are included to control dust emission from bauxite conveyors at the Gramercy Works.

## Alumina Trihydrate Calcination

The kiln feed is a filter cake of alumina trihydrate and 10- to 12% free moisture. The handling characteristics and appearance of dry hydrated alumina is similar to clean, dry



**THE BIN SECTION** above the active alumina storage (left) serves as a plenum chamber for all dust connections and also as a settling chamber dust collector.

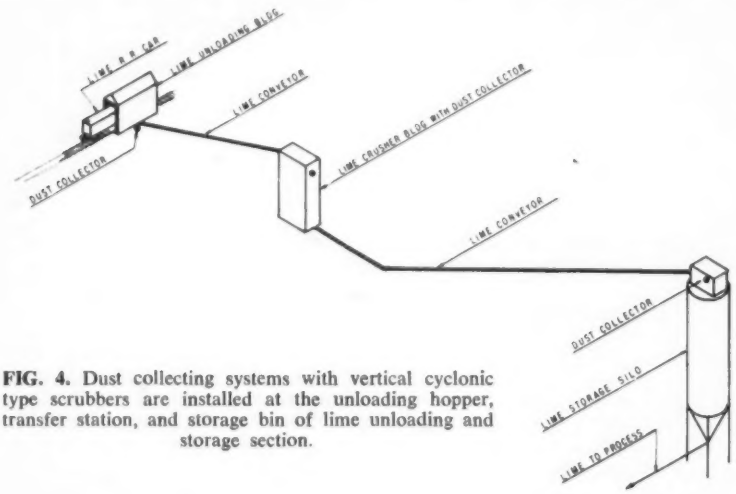



**FIG. 4.** Dust collecting systems with vertical cyclonic type scrubbers are installed at the unloading hopper, transfer station, and storage bin of lime unloading and storage section.

sand with the same particle size range.

The alumina trihydrate is calcined to alumina in two rotary kilns using natural gas. Exit gases discharge from the kiln at 400- to 500° F, and the entrained dust is a mixture of alumina trihydrate and alumina. Gas from each kiln passes through a three-stage dust collection system: an inertial type collector, a multi-cyclone and an electrostatic precipitator.

This system gives a very high collection efficiency and also provides flexibility in handling dust. The relatively coarse dust collected by the first and second stages is returned directly to the kiln through a special feeder designed to minimize re-entrainment. Dust collected by the precipitator is very fine and may be returned to the kiln or used elsewhere as desired by operators.

## Alumina Handling Facilities

The kiln product, alumina, is also a white granular powder with the same general characteristics as dry alumina trihydrate, except that it has a lower bulk density.

Three dust collection systems serve alumina storage and loadout facilities at Gramercy. All of these utilize bag collectors in which cotton or nylon bags filter the air stream. The collector housings are divided into compartments so that gas flow through a single compartment may be shut off automatically while the bags are shaken for cleaning.

The first of the control systems is at the hot end of the kiln, with dust pick-up points at the kiln discharge conveyors, Fluosolids alumina coolers and belt-conveyor transfer points.

The second system is at the top of of the alumina storage bin, with pick-up points at the conveyor discharging into the storage bin, and at the belt receiving alumina from the storage bin.

The third system is located at the alumina loadout station (Fig. 3) and includes several unique design details. It provides ventilation for the hood over the belt conveyor discharging into the top of the bin and from each of 30 chutes for loading closed hopper cars or box cars under the bin. The bin section above the active alumina storage serves as a plenum chamber for all duct connections and also as a settling chamber dust collector.

The conveyor discharge chute is equipped with an air seal "trickle" valve, and the hood over the belt discharge is connected to the top of the bin by a duct in order to limit flow of air from this point, which is closest to the collector.

Telescopic vertical chutes extending from the bin floor for loading closed hopper cars each have an adjustable air-tight manhole cover with vents to exhaust air and dust from the car. Vent connections of flexible air hoses equipped with manually controlled dampers deliver air to vertical pipe ducts extending to the upper section of the bin.

Although most alumina is shipped in closed hopper cars, the loadout station was also designed to permit loading box cars through the side doors. A pneumatic booster is utilized with the bin chute to deliver alumina to the ends of the cars. Pivoted hoods are provided to cover the open door area, and have duct connections to deliver dusty air vented from cars to vertical pipe ducts in the bin.

The bag filter is located on roof of the bin and has no hoppers. Dust discharged from the bags falls directly into the bin.

## Lime Unloading and Storage

The lime used at Gramercy is primarily from the calcination of clam-shells, which arrive by rail in closed hopper cars. As received, the clam-shells are approximately 95% available calcium oxide and 5% sand.

When received, lime is discharged from the cars to a covered conveyor belt for transfer to the lime storage bin in the Clarification Department. The same facilities can be used for unloading rock salt for the chlorine plant, thereby requiring a transfer station between the unloading area and the storage bin. Dust collecting systems with vertical cyclonic type

scrubbers are installed at the unloading hopper, transfer station and the storage bin.

### Starch Material Handling

Because of explosive characteristics of starch dust, spark-proof bag collectors were selected for those systems which handle this material.

Starch is received in Airslide railroad hopper cars. The starch is conveyed from cars to storage bin located 1,000 ft away by a pneumatic conveying system. The bin is vented through a collector located on the roof. Another dust control system is installed in the mixer building to ventilate the Weightometer, feeder and conveyor which deliver the starch from the bin to the slurry mixing tank.

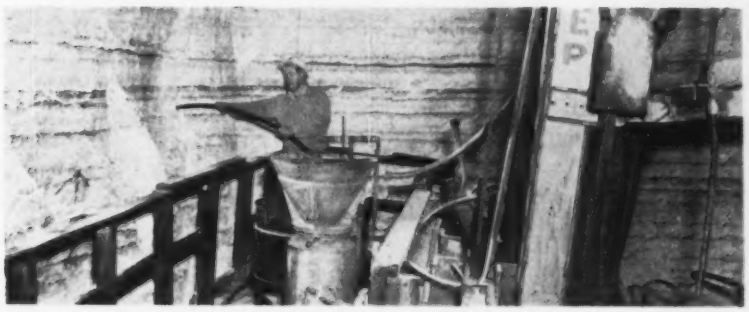
### Caustic Chlorine Plant

In producing chlorine in a chlorine-caustic operation, the cell gas containing chlorine is laden with moisture and contains some inert gas, mostly carbon dioxide, air and a small fraction of hydrogen. The gases are cooled and dried to a low moisture content in sulphuric acid drying towers, and then compressed as a feed to a chlorine liquefier which further cools the gas and condenses liquid chlorine from it.

Exit gas from the chlorine liquefier is fed to a water scrubbing tower, called a blow gas absorber, which removes most of the remaining chlorine by absorption. The chlorine is recovered in another part of the process by heating the water to boiling, thus freeing it. Gas leaving the scrubber contains less than 1% of the feed to the liquefier. To insure that even this small amount of chlorine is not released to the atmosphere, a special tank is provided containing caustic through which the gas is passed and allowed to react, thus removing the remaining traces of chlorine before the gas is finally released to the atmosphere.

### Performance

All of the materials handling and dust collecting equipment are performing satisfactorily. A few changes have been made in the bauxite handling equipment to improve its performance, but operation of the air pollution control systems at Gramercy has met the design expectations.



**JETLOADER** on fork-lift truck platform air-loads A-N at the Detroit Mine.

# A-N: Secondary and Underground Blasting

"AMMONIUM NITRATE-FUEL OIL MIXTURES used in conjunction with a Number 6 blasting cap, the correct booster and a few shovels full of mud, offer a solution to reducing costs for secondary blasting. Variations of boosters and booster weight-prill weight ratios, used intelligently by commercial operators can control the size of fragmentation as dictated by his requirements" according to James O. Milmoe and T. R. Young, Colorado School of Mines Research Foundation, Golden, Colo.

Speaking at the CMA meeting at Denver, April 22, the authors went on to say, "Because of the relatively low cost of the explosive, a high loading factor should be considered, in order to eliminate the labor costs of drilling. A one gallon size ice cream carton, about 7x7 in., proved to be a convenient size container for mixing and handling up to 6 lb of N-IV fuel oil mixture." It was found ". . . that the carton alone does not offer sufficient confinement. However by placing the carton on the rock and packing the mud around it, then pulling the carton out, a well is rapidly and easily produced into which the prill can be poured. This also insures intimate contact between the prill and the rock. This coupling is very important in obtaining maximum useful work from the explosive."

**The Detroit Rock Salt Mine** is blasting underground with ammonium nitrate explosives. Plant manager for the mine, John L. Ryon, Jr., tells how International Salt Co. Inc. has found no significant concentrations of carbon monoxide and oxides of nitrogen. Speaking at the Fifth Annual Symposium on Mining Research, Rolla, Mo., Ryan added, "We have also repeated checks for traces of static electricity in our drill holes loaded with ammonium nitrate by the pneumatic placement method and again without exception we have never been able to pick up any readings."

"Our fragmentation is excellent, being, we believe, superior to that experienced in using dynamite. We have practically no large chunks and a minimum of fines. Our face profile is vastly improved in that we have a slightly toeing out of the room at the bottom with no overhang. In other words, the face of the room tends to be slightly concave. This greatly simplifies that final cleaning of rooms prior to undercutting. This we do with a front end loader. The improved profile of the faces also allows us to get a full cut with the undercutter bar.

"Pound for pound we have found that ammonium nitrate fuel oil mixture for blasting gives us at least equivalent performance when compared to dynamite. At 3½c per pound for ammonium nitrate as compared to 18 to 20c per pound for dynamite, the cost economy of this change is obvious.

"At Detroit we are presently performing our blasting operations cheaper and more satisfactorily than we have ever done before, and after a full year of experience with the use of ammonium nitrate fuel oil mixture for blasting on a regular production basis, we are more sold on the operation than ever."

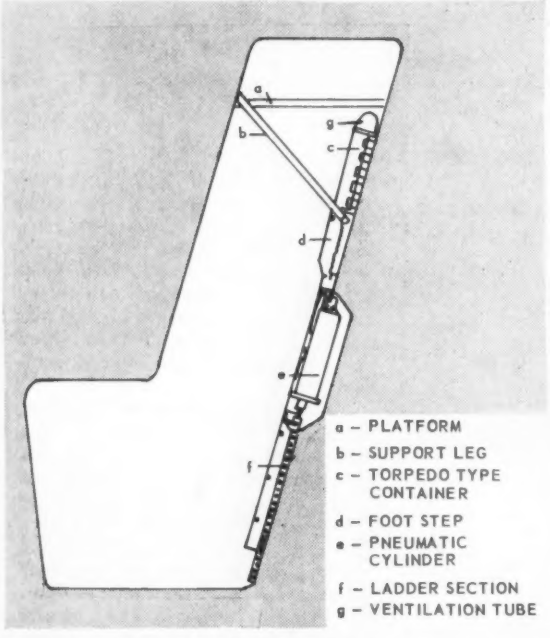
FROM THE SYMPOSIUM

# New Ideas in Raising, Shaft Sinking,

"THE IMPORTANCE of improving mechanized methods of driving raises and sinking shafts in order to prolong the working life of the personnel engaged in these undertakings," was stressed by V. S. Epstein, head of the mine planning section, development department, LKAB, Kiruna, Sweden. This concept has significantly improved raising methods and machinery with worldwide acceptance of Swedish developments. The improved methods are not only safer but also faster.

Mr. Epstein's remarks were contained in a paper presented at a symposium on shaft sinking and tunneling held in London during July 1959. During the meeting, organized by the Institution of Mining Engineers, some 25 papers were delivered by authors from 14 countries. A bound volume of the proceedings will be available from the Secretary of the Institution of Mining Engineers, 3 Grosvener Crescent, London, S.W. 1. Information in the following article is extracted from papers presented at the symposium.

Swedish raising methods have progressed from conventional two-compartment raises and single-compartment raises to raising by use of the steel ladder platform, the drilling platform, long holes, and the drilling platform elevator.



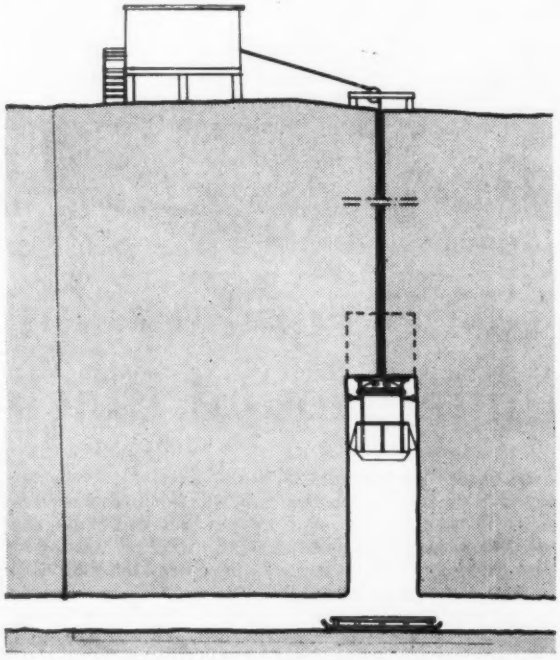

**STEEL LADDER PLATFORM** has torpedo type container to house platform planks and drilling equipment during blasting.

## Steel Ladder Platform

A natural development of raising methods was the steel ladder platform which was first tried in 1952. The lower part of the steel ladder consists of a powerful air cylinder, which can push up the whole construction so that a new steel ladder section can be added. A drilling platform is arranged over the top of the ladder which consists of a strong "torpedo-shaped" cylinder with lids. The platform planks and drilling equipment can be protected in this cylinder during blasting. The semi-cylindrical sheet metal tube serves as a ladder, incorporating the provision of notches formed in the metal. Air and water hoses and electric cables run inside the ladder and can easily be coupled to the drilling equipment from the "torpedo." The ladder-pieces are 2 m each and are locked very tightly to each other. The entire construction is strongly made and cannot be damaged by falling rocks.

The setting-time for drilling a round is decreased since both the work of timbering and removing the timber afterwards is eliminated. The ventilation takes place quickly and effectively because air is brought near the top of the raise from the bottom. The ladder can be used for at least five raises and the cost is less than a timbered raise.

The steel ladder platform has its limits, however, for it can only be used in an inclined raise with a dip not more than 65°.



**DRILLING PLATFORM** is economical when several raises can be driven close to each other and the same machinery used.

## Drilling Platform

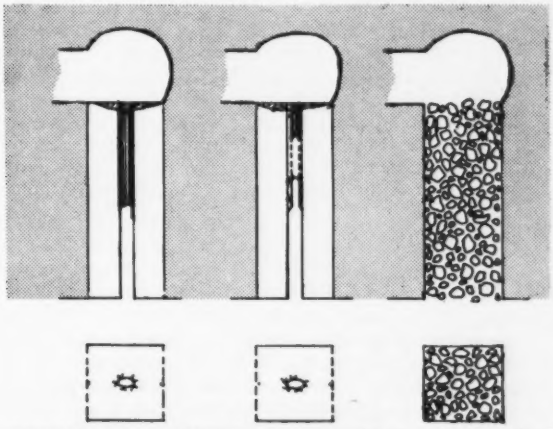
This type of platform is used while drilling and loading is carried on and has to be removed each time blasting operations take place on the face.

For driving their pen-stocks the Swedish State Power Board has developed a platform which is hoisted by a wire fed through a previously drilled large hole. A churn-drill is used for drilling this hole which usually has a

# Shaft Planning and Tunneling

diameter of 150 mm. Personnel and material are easily brought to the face and the large hole is used as a "cut" in the round pattern. Before blasting operations the platform is lowered down and moved aside to the next raise by a skid-mounted carrier.

This method can be used for vertical raises with heights between 50-100 m. Because of the expensive hoisting equipment it is only economical when several raises can be driven quite close to each other and the same machinery used. The advance attained with this method has been 0.7-1.0 m per manshift.



**DRILLING LONG HOLES** is accomplished with the aid of a guide made of a cast concrete slab with steel tubes.

## Raising With Long Holes

Another line in developing new methods for raising is based on doing all necessary drilling, either from the underneath, or where preferable, from the top. One or several large empty holes (100-150 mm) for the cut are drilled, and around it or them a number of smaller holes are charged. The blasting is done in several rounds from the upper level. The charges are brought into position using lines through the holes; the advance has varied from 2 to 4 m per round.

Diamond drilling has been used but this is a rather expensive method. Great effort has been made by Atlas Copco to develop equipment to make such drilling possible by using percussion drilling machines.

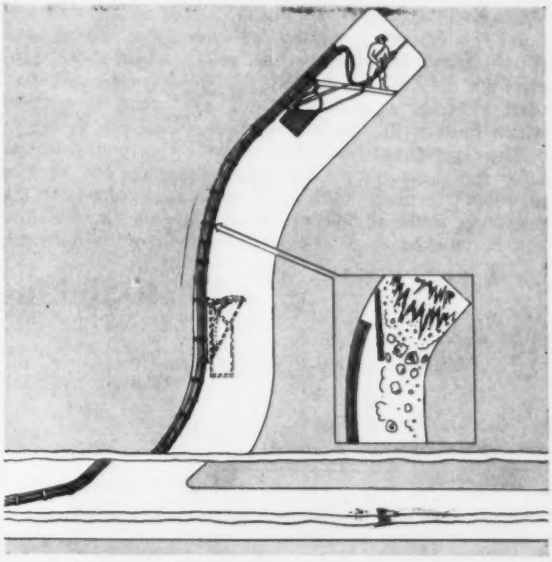
The greatest difficulty is to get the holes straight and correctly directed. Special guiding arrangements are used for keeping the holes parallel with the direction of the raise and trying to get a minimum of deviation between the holes.

On the drilling site it is practical to cast a concrete slab with steel tubes through which the holes should be drilled. These tubes are 300-400 mm long and help to direct the steel while drilling. The driller does not have to rely entirely on the feed of the rock drill.

A 6-in. drilling machine using 51-mm extension rods and 100-mm bits for the large empty hole, and 38-mm extension rods and 64-mm bits for the blast holes has proved to be capable of drilling raises up to 40-45 m without too much trouble. The blasting from the upper level has been successfully carried out up to 30-35 m, while the first 10-15 m has been blasted from underneath.

The area of the raise has varied from 4 to 6 sq m. Besides the difficulties encountered in drilling the holes, it is necessary to survey the position of the holes in order to charge and initiate them in a right manner.

Driving raises with long holes is practiced throughout Sweden. The results are very promising and give great expectations for the future of eliminating all the present risks in raising. Every mining engineer dealing with the problem is putting all his efforts into the successful development of this method.



**THE ALIMAK PLATFORM** elevates the driller to the drilling site and, after he descends, is folded back for blasting.

## Drilling Platform Elevator

The first two drilling platform elevators were delivered in November 1957, for testing at the Boliden and Malmberget mines. They were used to drive 65-m long vertical raises. Conventional methods of driving these raises were too expensive and involved too many risks. Swedish mining engineers and contractors produced the ideas and inspired the Alimak factory—a famous firm of constructors of outside elevators for the house building industry — to solve the construction problems in developing a drilling platform elevator for raising.

The results obtained at the first test were so promising that the work on developing the elevator was intensified. Today there are about 30 drilling platform elevators in use in Sweden.

The elevator consists of a steel-plate platform with an "umbrella-shaped" detachable shelter on a 2-m high post. This is a cover for the operator while he is scaling the face. The platform is raised by a compressed-air motor which has a pinion climbing a rack-equipped guide rail. The first elevators in use were designed only for vertical raises, but the new construction permits driving inclined raises if the platform is hinged to the guide. The guide rails are mounted on the hanging wall of the raise. The traveling speed of the elevator is 10 m per minute and

the maximum permissible load on the platform is approximately 500 kg. The elevator is mounted on a transport trolley from which the raising is started; from this position the first round is drilled and blasted in the roof of the tunnel. At the same time a recess, where the elevator may be withdrawn when the rounds are pulled during the raising, is blasted out from the wall. The first guide rail is next fastened by eight expansion bolts to the wall (in inclined raises—at the hanging wall). To ensure that this lower section of guide rail shall sit squarely, a concrete sole is cast behind it. When the concrete has set, the raising may be undertaken.

The operator is raised to the working face where he drills for charges. After he has descended, the platform is folded back for blasting. For the protection of the top end of the guide rail and the rack, a special head-box and cover are arranged over the guide rail top. All necessary services for the drilling operations—air, water, electricity and telephone—are being carried in the rail section. The guide rail consists of three tubes which have a tight connection between the rails. The head-box protects not only the top rail but is also so constructed that, after blasting, a mixture of air and water is sprayed which hastens the evacuation of the explosive fumes.

The operator then again ascends the platform and after the necessary scaling he fits another one or two metre rail sections. Then he is ready to recommence the operation cycle. While he is drilling, the rock blasted can be mucked away after every second or third round. All operations with the platform are carried out by one man.

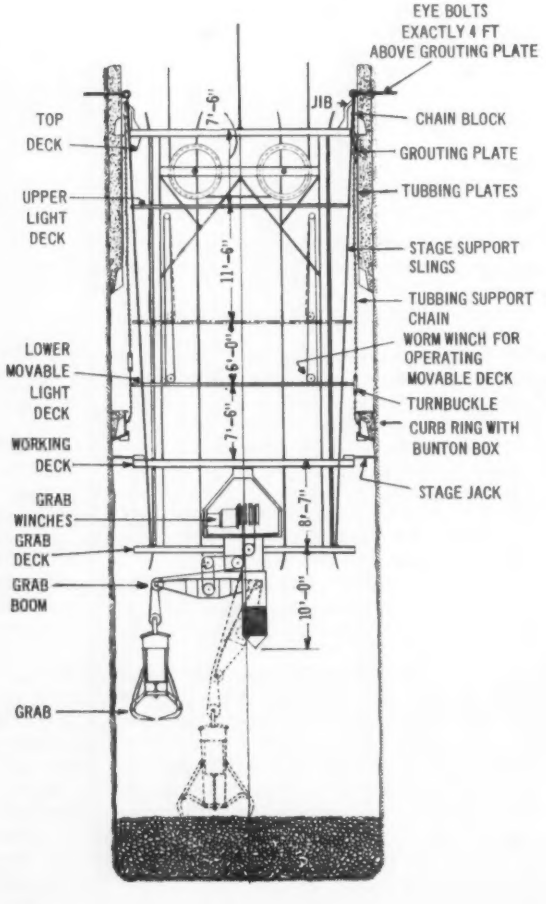
The design of the platform incorporates many safety factors, such as telephone communication between the platform and the bottom level, special climbing iron "shoes," a grappling hook and a lifeline. If the compressed-air supply fails, the operator can use this equipment; and he can also be lowered by turning a hand crank.

When a raise has been completed the expansion bolts and the guide rails are easily removed to serve in the next raise.

Other features of the drilling platform elevator are that the platform is equipped to carry all necessary drilling tools; the air and water hoses are brought up to the connections at the hinged part of the elevator and are attached to the tunnel roof. The hoses are not in the way of the elevator when it is swung clear of the raise. A compressed-air-driven winder for the air hose to the elevator machinery automatically keeps the hose close to the wall while the platform is traveling up and down. The operator controls the traveling of the elevator from a position under the platform.

The Alimak drilling platform elevator will give an advance of more than 2 m per manshift. As there are no ventilation problems, two rounds per two-shift-day have been obtained. Little maintenance is required and a guide rail can certainly be used for 2,000 m or more before it has to be replaced.

# Shaft-Sinking in South Africa




"Probably the greatest advance in mining technique in South Africa during the last decade has occurred in shaft sinking practice. . . . We in South Africa look forward to the day when a sinking footage of 1,000 ft per month will be . . . accepted as normal." These are the words of H. MacConachie, consulting engineer to the Anglo American Corp. of South Africa Ltd.

Until about 15 years ago, the recognized advantages of concrete-lined circular shafts were not generally sufficient to outweigh their relatively slow sinking-speed, except when the time factor was of small importance, or the difficult nature of the strata to be penetrated was an overriding consideration. The speed of sinking circular shafts has now been greatly increased by techniques which enable sinking and lining to be carried out concurrently instead of in alternating periods as formerly. Operations involve the use of various types of sinking stages, mechanical cleaning equipment and multi-rope hoists for raising and lowering the stage.

It is generally accepted in South African sinking practice that an eight-hour shift cycle from blast to blast gives the best results, as a definite and incentive routine task is set for each shift; i.e. to clean-out, drill and blast a round of predetermined length in eight hours. Each crew takes a pride in completing their full cycle of operations and competition ensues to accomplish this task in the time allotted; if the time taken to complete a cycle is greater or less than eight hours, the length of round drilled is correspondingly altered. Experiments have been carried out with six-hour shifts and although this scheme had some advantages when cleaning of the round was done manually, with the advent of mechanical cleaning this slight advantage fell away. A typical shift breakdown is given in Table 1.

**SINKING STAGE** for 24 ft dia shaft has vertical height sufficient to pour 30 ft of shaft-lining from one curb ring.

The drill steel used is usually of ⅞ in. or 1 in. hexagon, chromemolybdenum alloy, with tungsten carbide tips; and the rock drills generally are of 3-in. bore and hand-held. The use of hole directors is standard practice and drilling to a definite pattern is strictly enforced. The accuracy with which a long round has to be drilled in a circular shaft is of extreme importance. Any small protrusion of rock from the side wall can foul the stage or the shuttering, delaying the whole cycle of operations while it is removed and, conversely, overbreaking requires additional unneccessary concrete filling. Electric blasting from the surface is universally used with a sufficient number of delays in detonation to ensure the blasting of the round in correct sequence. The number of holes drilled varies with the size of the shaft but is usually of the order of 100 to 150.

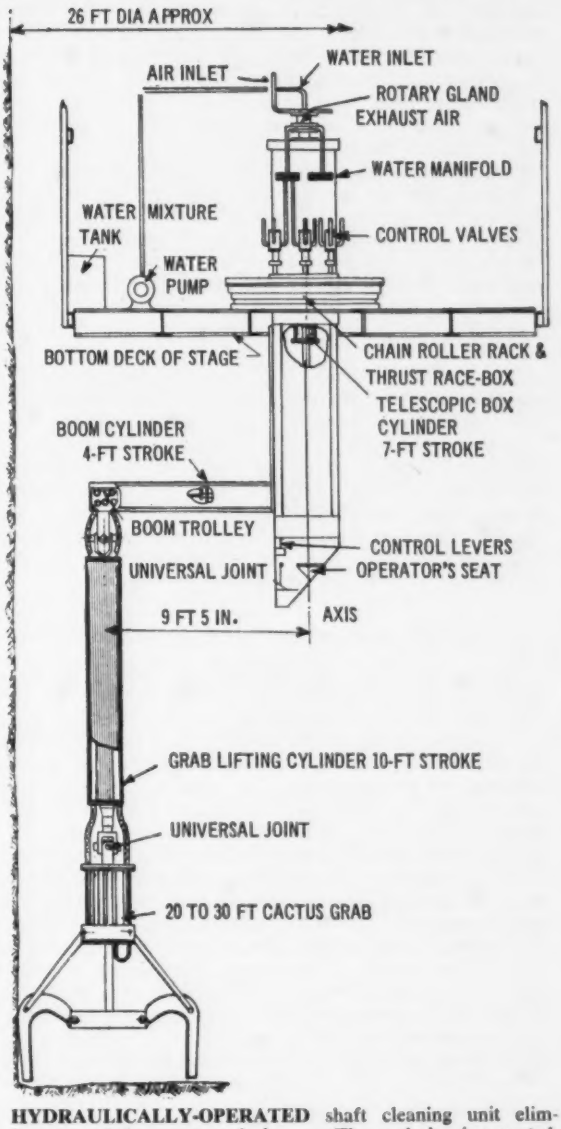
When the round has been practically cleaned out, the bottom of the shaft is blown over by means of compressed air and water which collects the last of the debris and exposes the sockets of the previous blast; these are pumped out to ensure that no undetonated explosives are present and then plugged with wooden socket-plugs. A plumb-wire fixed on a hand winch suspended over the center of the shaft from the surface and normally kept just above the top deck of the stage is then lowered through special holes in the stage to the shaft bottom, thus marking the shaft center. At the center position thus obtained a hole is drilled vertically and, using two chains pivoted over this center hole and stretched towards the shaft perimeter, the sinker then determines from fixed marks on each chain the concentric circles on which the holes are to be marked off. The direction of the cut holes is obtained from a hole director which is placed over a drill-rod in the center hole of the shaft and pivoted around this rod, the periphery holes being marked from lines suspended from the curb ring above. The various blow pipes, drill steel, socket plugs, air pumps and drilling machines are sent down in special kibbles partitioned off for the different items and below this kibble are slung the necessary machine air and water manifold connections. Each manifold has air and water connections for attaching either to the various shaft mains or to main manifolds on the stage, and safety slings are used to suspend the machine manifolds and hoses from the bottom of the stage. The air and water hoses of the machines are then connected to the appropriate manifolds for drilling. It is usual to employ from 18 to 20 machines, depending on the number of holes to be drilled. Residual water from drilling in the shaft bottom is pumped into the kibbles and discharged on surface. On completion of drilling the holes are blown out and then charged up. The charged holes are connected up to the bus bars in the shaft bottom and, as the last of the crew leaves the bottom, the bus bar leads are connected to the permanent shaft-blasting cable from the stage.

## Table 1—Average Shift Times—Sinking and Lining

| Sinking | Time in Minutes | Lining | Time in Minutes | Lining |
|---|---|---|---|---|
| Re-entry | 15 | | | |
| Lower stage | | Lower and pre- | | |
| Examine | 210 | pare curb ring | 100 | Complete lining |
| Cleaning round | | Pour curb ring | | cycle and ex- |
| Blowing over | 60 | Place shutter | 30 | tend shaft on |
| Drilling | 90 | Pour shutter | 90 | other shifts |
| Charge and blast | 75 | | | |

Total time: 7½ hours

Average advance per blast: 8 ft




**HYDRAULICALLY-OPERATED** shaft cleaning unit eliminates need for ropes and sheaves. The grab is air-operated.

The sinker, who is the last person to come to the surface, blasts the round by closing a switch in the special blasting cubicle at the shaft bank. The key to this cubicle is retained by the sinker at all times. Prior to blasting, the stage is raised some distance from the shaft bottom to remove the mechanical cleaning unit and other stage equipment from the immediate vicinity of the blast.

On the expiry of the approved re-entry interval, some members of the crew are lowered directly to the stage, which is examined for damage, cleared of any broken rock scattered from the blast, and lowered to its correct position for shaft bottom cleaning operations. The safety slings are then shackled to the bottom deck of the stage and the stage lowered until the slings are taut. Where the eight-rope stage suspension is used it has not been found necessary to use safety slings, as the complete weight of the stage and the mechanical cleaning unit is carried by the eight ropes with a minimum of oscillation. The pneumatic jacks are then brought into operation and jacked to

the side wall. These jacks, together with the safety slings, when necessary, steady the stage during the operation of the mechanical cleaning unit. The remainder of the crew is lowered and cleaning commences. In the case of one double-drum hoist being available for cleaning, four kibbles are used, two kibbles being filled while the other two are traveling in the shaft. When two hoists are used, six or seven kibbles are in commission for a portion of the shift —two or three are in the bottom while four are in transit. In the latter case the two hoists are usually only used for a portion of the cleaning shift, because as the amount of broken rock is reduced it is more convenient to use only one hoist. The operator of the mechanical cleaning unit usually sites himself under an ascending kibble, and the descending kibble cannot enter the shaft bottom until it is signalled in.

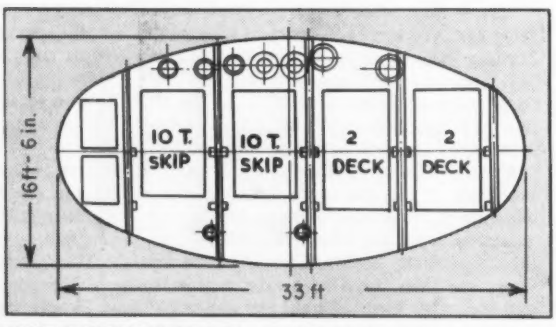
The general procedure is to clean initially around the periphery of the shaft, the mechanical grab excavating a hole into which the descending empty kibble is placed. This facilitates the handling of the chains and shackles of the kibble and leaves a center pile for the crew to stand on. As the depth of rock is reduced, the center pile is reduced proportionately and the mechanical grab cleans out all but the five to ten tons which are removed manually. The shaft bottom is then blown over, the first of the broken rock removed and preparation for drilling commenced.

### Lining and cementation operations

During the cleaning period of the shift the curb ring is slackened off from its previous position by removing the key plate. The ring is lowered by the stage winches to its new position, usually a distance of 15 ft or 30 ft depending on the lift of concrete to be poured. The key plate is then replaced, the weight of the ring taken up by slings suspended from the shuttering above, and the winch ropes detached. By means of plumb-bobs and steel tapes suspended from brackets in the previous lining, the curb ring is levelled and centered to its exact position. Fine adjustment is accomplished by using the turnbuckles in the slings. Particular care is exercised during this operation. The careful setting of the curb ring and bunton boxes in each lift of concrete in relation to plumb-wires and tape brackets is most essential. The ring is then secured and blocked in its correct position using sprages and wedges. One or one-and-one-half in. scribing boards are then inserted in the slot provided at the base of the ring to seal off the space between the side wall and the ring. The boards are secured by small wedges in the base plate. At any place where, due to overbreaking, the length of the scribing boards exceeds 24 in., they are supported by pins from the side wall. Finally, all cracks between the boards are stuffed with discarded paper cement bags. The octopus hoses are then connected; and concrete, to which a quick-setting agent is added, is poured and the complete curb ring filled. Thereafter, further rings of shuttering are lowered, bolted into place, plumbed and wedged prior to concreting. This process is continued until the lift is completed. A lining rate of 10 ft per hour has been achieved, but a complete cycle of 30 ft of concrete lining together with pipe and service extensions usually takes place over three shifts. During the first shift after a lift of lining has been completed, the scribing boards at the bottom of the last lift are stripped together with the grouting ring joining the top of this lift to the one above; and any protruding concrete at this joint is chipped away to make the joint even. The various service columns and cables are then extended and all preliminary work for lowering the curb ring is completed. On the second shift the curb ring is lowered, set in position and concreted together with two or three lengths of shuttering and the third shift completes the cycle for a 30-ft lift of concrete and grouts the joint to the lift above. Particular care is taken during the installation of the concreting pipe, which is set to templates from plumbing-wires, to ensure complete verticality.

As most of the shafts now being sunk traverse water-bearing strata to varied degrees, it is normal practice to sink with full cementation cover. This is usually done by drilling percussion holes to a definite pattern and to a depth of 100 to 175 ft ahead of sinking. Casing holes of large diameter are drilled to a depth of 8-10 ft and cased with steam piping set in cement, the casings being fitted with stuffing boxes and high-pressure cocks through which the extension drill-rods pass. Cover drilling is then done through the casing with hand-held machines using 10-ft jointed rods, and where water is intersected the hole is stopped and cement injection commences. Various theories are held regarding the correct pressure to attain for sealing off, but the generally accepted practice is to seal off a pressure of one lb per sq in./ft of shaft depth with a minimum pressure of 500 lb per sq in. In ground where heavy water is anticipated as many as 16 cover holes are drilled to a predetermined pattern, but where water is not anticipated this may be reduced to six holes.

# Shaft Planning for New Consolidated Gold Fields Mines




**WEST DRIEFONTEIN,** No. 2 shaft design allows space for large skips and decks, with a minimum of wasted space.

"Much has been written in the past on 'How' various types of shafts are sunk, but little has been published on the subject of 'Why' they are sunk," according to D. M. Jamieson, M.C., assistant consulting engineer, New Consolidated Gold Fields Ltd., and M. P. Pearse, M.C., senior technical assistant to the company. The following extraction is an assessment of the dimensions of a required shaft.

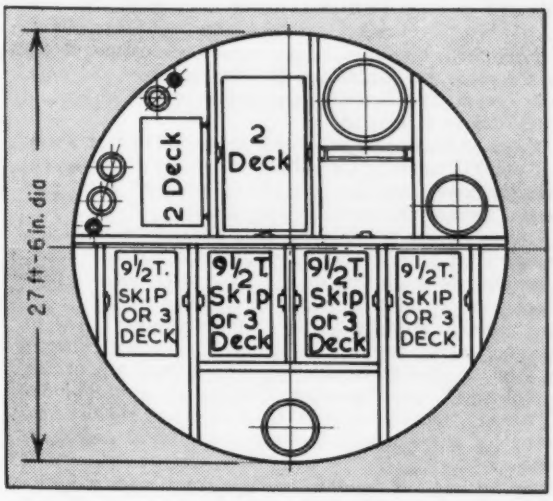
**The total area of the skip compartments**

When calculating the number and size of the skips which will be required to hoist the desired tonnage it must be remembered that:

1. The number of hoisting trips per hr decreases as the shaft becomes deeper if the winding speed remains constant.

2. As the number of trips per hour decreases so must the original payload be increased in order that the required output may be maintained.

3. As the payload is increased, so must the size of the rope be increased in order to maintain the statutory factor of safety.




**SAAIPLAAS,** No. 2 circular shaft design gives both the greatest capacity for ventilation and greatest strength.

4. As the depth of the shaft is increased, a heavy payload and therefore a heavy rope means, in the case of a drum winder, that the out-of-balance load, when the skip is at the loading box, will increase very considerably. The horsepower of the winding plant to be installed must therefore be increased for deeper shafts, involving greater capital cost.

Three alternatives are available which offer some relief to the problems of increasing complexity for deep shafts.

1. By increasing the winding speed, thus allowing a smaller payload and rope. Increased speed involves greater horsepower and a corresponding increase in capital cost.

2. By the use of a multi-rope friction hoist, in which the load is carried by two or more ropes of small diameter. The ropes are always in balance so that the out-of-balance load is never greater than the payload. The horsepower required is therefore considerably less than that of an equivalent drum winder and consequently a smaller capital outlay is involved.

3. The use of automatic hoist controls results in greater output by eliminating delays and by maintaining a more uniform winding cycle.

When planning shafts of the order of 7,000 ft in depth many of the hoisting conditions are approaching the limit of practicability. For example, long ropes of more than 2 in. dia introduce their own problems of transport, handling and maintenance, and are therefore not favored by this group.

The limitations of the payload that can be hoisted from great depths may be appreciated when it is realized that a freely suspended rope made of special improved plough steel would break due to its own weight if its length were approximately 55,000 ft. The statutory requirements for drum winders in the Union of South Africa state that, after allowing 10% for deterioration:

(a) No load greater than one-tenth of its breaking load may be attached to any rope;

(b) The static factor of safety, when the load includes the weight of the rope, shall not be less than 5.

Hence the load that may be carried by any rope cannot be greater than the weight of 55,000 ÷ 5, or 11,000 ft of its own length. If it is desired to hoist from a depth of 7,000 ft the total weight of skip and payload cannot, therefore, exceed the weight of 11,000 - 7,000 = 4000 ft of rope (determined by [b] above).

If a rope 2 in. in dia weighing 7 lb per ft is used, then the total weight of skip and payload cannot exceed 4,000 x 7 = 28,000 lb or 14 short tons and the payload, which may be taken as 0.62 x-total load attached to the rope, cannot exceed 8½ tons.

At a maximum winding speed of 3,000 ft per minute the corresponding maximum output would be 178 tons per hour. If it is desired to hoist from 8,000 ft the payload would be reduced to 6½ tons and the output to 125 tons per hour. For purposes of comparison, from a depth of 3,500 ft, the payload would be 11.5 tons (determined by condition [a] above) and the output would be 430 tons per hour.

It will thus be realized that the problem of hoisting from very great depths introduces restrictions which cannot be accepted if an alternative can be found.

The question then arises as to whether it would not be better to raise the required tonnage in two stages of moderate depth than to attempt to raise it in a single stage of great depth; bearing in mind however that stage-winding is expensive in both capital and maintenance cost and delays the competition of the shaft system.

The answer to this question can only be arrived at after an exhaustive study of all the relevant factors, in conjunction with the long term policy of the mine: it will affect the layout of the mine and probably the future mining program.

Arising from a study of, and a solution to, the foregoing problem, the decision will be made as to:

(a) The number and type of hoists to be installed and whether they are to be for single or dual purposes.

(b) The sizes of the conveyances.

(c) The general arrangement of compartments.

**The total area of the cage compartments**

The number of persons to be lowered and raised daily is determined by the planned rate of mining. It is normal practice to design the winding plant so that the full complement of persons can be lowered within a period of one and a half hours and with this in view at least one of the rock winders is equipped with interchangeable skips and cages.

One large cage with a balance weight or a pair in balance is usually provided to deal almost exclusively with the transport of men and material. It is important that the dimensions of these cages and compartments are sufficient to accommodate without restriction the largest pieces of equipment which have, periodically, to be transported through the shaft. Such items include locomotives and large pump motors for a workshop overhaul. This latter consideration will often determine the floor dimension of the cage; its capacity for carrying men will depend on the number of decks which are found to be necessary in order to transport men at the peak rate, in conjunction with the dual-purpose rock hoists.

It is an advantage to provide a small single or double drum hoist to operate a conveyance for the movement of persons between levels during the shift. Such an arrangement avoids wasting the time of the large cages when they are required for the transport of important material.

**The total area of the shaft**

After the total area that is required for skips and cages has been calculated the area has to be checked to see if it is sufficiently large to pass the ventilation currents required for the area to be mined.

Velocities of 1,500 ft per minute in the equipped portion of the shaft are considered as the maximum, but velocities up to 2,500 ft per minute are considered economic in any portion of the shaft that is isolated for ventilation

only and is devoid of steelwork which would impede the air flow. The minimum area of the proposed shafts can be decided after an allowance of 25% has been made for the accommodation of steelwork, cables and pipe columns for compressed air, water service, pumping and drainage operations.

**The shape and equipment of the shaft**

Following the calculation of the shaft area it becomes necessary to decide its shape. The choice lies between square, rectangular, elliptical or circular. The shape most commonly adopted in this group today is circular in spite of the fact that the circular shaft does not allow for the best arrangement of conveyances.

The reason for this design is that most of the shafts being sunk are for the exploitation of orebodies lying at considerable depths where rock temperatures are high and where the shaft normally passes through water-bearing strata.

The circular monolithic concrete-lined shaft gives both the greatest capacity for ventilation and the greatest strength to resist the pressures encountered in fissured water-bearing rock which is being cemented while sinking operations are in progress.

Having decided upon the minimum area of circle required and knowing the cross-sectional dimensions of cages and skips and larger columns, it then becomes necessary to fit this equipment into the circle to the best advantage. The method commonly adopted is to cut scale model templates of the conveyances and, by trial and error, to fit them into the scale model of a shaft circle in such a manner that the minimum of space is wasted, bearing in mind, however, that the compartments should be placed so that the buntons and dividers form a mutually supporting and adequately rigid structure.

When the arrangement of the various compartments has been decided, the location of the headgear bins, the main shaft bottom loading boxes and any intermediate loading boxes, can be orientated.

The main loading boxes should be situated in such a way that there is capacity for storing a full day's production, from the lowest working level, in the ore and waste pass systems feeding the main loading box.

This can often be achieved more cheaply by providing several shorter orepasses delivering to a common level, rather than by deepening the shaft the extra distance necessary to allow sufficient length for a single orepass.

In order to estimate the cost of the steelwork and to plan the sinking procedure, the vertical distance between the steel sets has to be decided. The normal practice at present is to fix this distance at 15 ft and to use steel guides of "top-hat" section which give the necessary rigidity and prevent excessive vibration of the conveyances and shaft steelwork.

The methods of handling spillage from loading boxes and water leakage down the shaft are then so arranged that they operate smoothly while normal shaft operations are being conducted. Ample provision should be made for the separate handling of grits, fine sludge and water. Sufficient sump capacity should be available as flooding of the shaft bottom can seriously interfere with normal mining operations at any shaft.

The layout and equipment of the proposed shaft having been planned so that it is capable of adequately handling the tasks for which it has been designed, it is necessary to consider the method of sinking to be adopted.

# Tunneling in Canada

M. A. Twidale, senior metalliferous mining engineer, and A. Ignatieff, chief of the Fuels Div., Mines Branch, Canada Department of Mines & Technical Surveys, offered a summary of special features and trends in Canada under the principal operations of tunneling practice. They first described three widely different tunneling projects and qualified their remarks by saying, "It is not possible to describe Canadian tunneling operations in terms of average conditions."

## Drilling

The hand-held, airleg-mounted drills continued to be the most universally used and efficient drilling equipment where short holes and small cross-section tunnels impose limitations. Incidentally, in stoping operations the small diameter hole shows a considerable saving in powder consumption, with satisfactory fragmentation. Further studies and experimental work are warranted in this field. In the trackless-mining field of low angle deposits, the 3-in. and 3½-in. drills, mounted on long shells and remotely controlled by hydraulic booms, dump and swing, are proving most efficient. Two miners are able to drill off a 12-ft round in a 10-ft x 12-ft heading in 3 hours. The "down the hole" drill has not, as yet, gained prominence in Canada for drilling a large-diameter cut. Considerable experiments were carried out with a diamond drill, but the cost was prohibitive. The heavy 4-in. drills proved their worth in the Chute-des-Passes tunnel, a recent hydro-electric development, where they were justified by the hard rock and the close time-schedule. A 3-deck jumbo and hydraulic boom mounting offset the weight of the machines.

## Blasting

In tunnel rounds the most widely used cut in hardrock mines in Canada is a 5 to 9 hole burn cut. The objective is to break the round efficiently to the depth of the drilled holes and control the resulting pile of broken rock. In achieving this objective, high-strength explosives do not necessarily give the best results. Therefore, spacers are quite commonly used in the holes to reduce charge concentrations. To provide free surface, large-diameter (1¾ in.) holes are drilled in the cut but not loaded with explosives. Also, to avoid the "freezing" of the cut, low-velocity explosives are then employed. In softer sedimentary rocks, Vee cuts are favored; in larger section tunnels, benching is often resorted to.

## Mucking

In the larger tunnels and the low-angle seam mining with sufficient headroom the caterpillar-mounted, short-boom shovel has proved very efficient, with minimum repair cost. Transport of broken material is generally by heavy dump-truck, if there is sufficient headroom, and by shuttle-cars, both diesel and electrically-powered, when headroom is limited. The Eimco 21 is still the popular, small opening, track-mounted mucking tool. The trackless miners find that when this unit is mounted on caterpillar tracks it is competitive with the mobile front-end and side loaders. The low head loader, using the gathering-arm principle with a short conveyor, has its place in the less abrasive material and where low headroom is essential. The old standby Conway loader was used on the Kemano tunnels where track, headroom and large tonnage of

coarse material were the controlling factors. It is expected that development will advance eventually to eliminate switching and to load full trains of ore-cars, without leaving the face, by the use of the scraper-mounted train and cars feeding one to another.

## Roof Support

Where support is necessary, rock-bolting, with its limitations, remains the standard form of roof reinforcement. The Chute-des-Passes tunnel, which was in Precambrian unstratified rock, proved the efficiency of a standard pattern of bolts, where again time was the controlling factor. Aluminum bolts were used in a section exposed to corrosion, and further studies of this use of light-weight material may adapt it to mining in general. There has been no significant change in roof support where tunnel-driving in broken, working or loose ground. Each condition dictates the method of support.

In asbestos mining, where the rock disintegrates rapidly on exposure to moisture and air, an application of gunnite is used to stabilize the walls and backs in temporary workings. In the case of main openings, such as haulage ways and crusher stations, reinforced concrete is used as permanent lining. Unreinforced concrete has been proved the most efficient in slusher drift-lining where shock and concussion from blasting are important factors. The use of movable forms, both aluminum and steel, is standard practice. In this industry the mixing of the concrete in a central plant, the transportation, and the placing by pump and pipe, have all reached a high degree of efficiency.

In hydraulic tunnels the concrete linings serve three purposes:

(1) To give the required hydraulic characteristics.
(2) To stabilize and support the roof.
(3) To prevent leakage when used in a pressure tunnel.

In the third case, careful pressure-grouting is necessary after pouring the lining.

## Ventilation and Dust Control

The developments in the past few years have been primarily in increasing the amount of fresh air circulating in the tunnel working areas. An extreme example is the Chute-des-Passes hydro-electric tunnel where ventilation fans consumed more horsepower than the compressors did.

Smaller tunnels universally use automatic water sprays with a compressed air blast as close to the blasting area as possible. Larger tunnels have used a water spray curtain to wash air leaving the blasting zone. In all cases the broken muck pile is well saturated before and during the mucking cycle, to allay as much dust as possible.

It is recognized that automatic water control valves on rock drills, water sprays on blasting, and wet muck piles are all vitally important in dust control; but once the dust and fumes are suspended in the air the exhausting of this foul air becomes of utmost importance.

In some high-speed tunneling operations, fogging at the drilling-face, resulting from the lower temperature of the compressed air exhaust and from the saturated air conditions, was such a handicap that it was economical to heat the compressed air with a heat exchanger mounted on the jumbo.

The question of exhausting foul air through ducts, versus ventilation with fresh air ducts, is usually settled by local conditions. The first alternative is always preferable. The use of diesel-powered units has required more volumes of air to clear the exhaust fumes, and all are equipped with water exhaust-scrubbers. In operating mines the exhaust gases are checked weekly for carbon monoxide fumes. Units that do not come up to the standard are removed from service.

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# The Supervisor and Safety

"KENNECOTT COPPER CORP. considers a supervisor's safety performance as one of the ten most important subjects in rating him. In rating a supervisor's safety performance, his accident record and the action taken by him will be closely reviewed by his immediate supervisor. In this connection, it has been stated by top management that all they have to do is look at a manager's safety record and they can tell if he is a good manager. They claim that if a manager's safety record is poor, the rest of his performance as a manager is comparable, because safety is management's number one responsibility." These are the words of Emmett K. Olson, Jr., Director of Safety, Utah Copper Div., Kennecott Copper Corp., Salt Lake City.

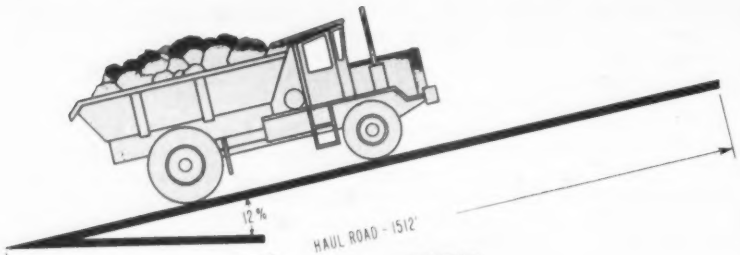
"A work center safety performance report was developed during the last quarter of 1958 and put into effect during January, 1959. In developing the work center accident control program, we recognized that work center supervisors, department heads and superintendents would need more information about the over all accident problems in their area of supervision.

"When an employee is injured, no matter how slightly, he has always been encouraged to report to the plant hospital for medical treatment. Under a new reporting system, the attendant fills out a new multi-copy 'medical report of injury' form. The safety engineer collects these reports each morning at the beginning of the shift. Copies of the reports are dispatched through plant mail to the respective front-line supervisors, work center supervisors and department superintendents. The safety department keeps a copy filed under the work center code number. An immediate investigation will be made of all reported injuries, regardless of their nature.

"When the safety department sends the copy of the medical report to the front-line supervisor, the new multi-copy 'Supervisor's Report of Accident' is enclosed. The supervisors know that this report must be completed and forwarded through higher supervision and returned to the safety department within two days after receipt. After reviewing the information in the medical report, the supervisor makes his own investigation, and interviews all personnel involved, including the injured employee's immediate supervisor and no one else.

"All copies of the report are sent to the work center supervisor, who adds his comments and views in the space provided and forwards all copies of the report to the department superintendent for his review and distribution of the report. The department superintendent's office sends one copy to the work center supervisor, one copy to the plant superintendent, one copy to the safety department and files one copy for future reference. This distribution insures that copies of the completed forms can be found in the files of the department superintendent, plant superintendent and work center supervisor for use as reference guides in reviewing the safety performance of subordinate supervisors under their jurisdiction."

# A FORMULA FOR COMPUTING PRODUCTION




$$P = E\frac{IH}{C}$$

**MACHINE PRODUCTION DATA SHEET**

User's Name ACME CONST. CO. Address CHILDERS, TEXAS
Project Location CHILDERS, TEXAS Elevation 1,500 (ft)
Type of Operation OPEN PIT Total Cycle Length 3,024 (ft)
Material to be handled BLASTED LIMESTONE Material Weight per Bank Cu Yd 4,200 (lb)
Total (Cu Yd) (Tons) to be moved ____ Working Days Allowed for Project Completion
Machine Production Required, (~~Cu Yd~~) (Tons) per Working Day Hour 300
Type of loading equipment 2½ CU YD SHOVEL
Machine considered for job Model 65 FAYHAULER

**PRODUCTION PER MACHINE**

| | |
|---|---|
| E – Efficiency Hour | 50 MIN. |
| I – In-Bank Correction Factor for Loaded Material | .58 |
| H – Heaped Capacity of Machine, (Cu Yd) (~~Tons~~) | 15.5 |
| C – Cycle Time in minutes | 8.72 MIN. |
| E x IH/C – Production in (Cu Yd) (~~Tons~~) per hour of one Machine | 51.5 |

$$\frac{(51.5\ \text{Cu Yd}) \times (4{,}200\ \text{lb})}{2{,}000\ \text{lb}} = 108.15\ (\text{Tons})$$

**PRODUCTION COST**

| | |
|---|---|
| Production Cost per (~~Cu Yd~~) (Tons): * Hourly Cost of owning and operating 3 IH 65's @ $8.64 Ea. = | $25.92 |
| Hourly Cost of owning and operating @ Ea. = | |
| Estimated production cost per (~~Cu Yd~~) (Tons) = Total hourly machine cost / Total machine production per hr = | $25.92 / 51.5 = $ .08 |

* Does not include overhead or other indirect job costs.

**MACHINES REQUIRED**

Number of Machines Required = Machine Production Required, (cu yd) (tons) per hr / Production in (cu yd) (tons) per hr of one Machine = 3

Total Machine Production per hr = (Production in (cu yd) (tons) per hr of one Machine X No. of Machines required) ..... 324.45

**THIS TRUCK** can haul 108 tons per hour over 1,512-ft haul road on 12% grade.

A 75 PAGE BOOKLET, prepared by the Sales Development Construction Equipment Div. of International Harvester Co., gives a complete coverage of basic estimating for production and costs of their equipment through empirical formulas and tables. Because of the usefulness of the information, simplicity and logical reasoning involved, a typical example is presented here for use as a guide by operators in their equipment selection and distribution, both preliminary and to meet changing conditions in the mine. It is believed that this type of reasoning can be applied to all producing elements and the guesswork taken out of operations.

Also it affords the operator the opportunity of analyzing his production in terms of what the manufacturer thinks ought to be produced by any given machine and of isolating the particular area of difference. For instance, the tables show that a 2½ yd shovel operating in well blasted limestone ought to load 335.4 tons per hr of operation, assuming a 90° swing.

The accompanying tables illustrate production and cost values for a typical truck. Only the necessary tables for this particular item of equipment are included. The basic production formula is explained in the following text, where production is expressed as a combination of the efficiency hour (E), in-bank correction factor (I) of material, heaped capacity of the machine (H), and cycle time (C) of the operation.

## P

Production is calculated in cu yd (tons) per hr and is equated to four basic factors which come into play wherever earthmoving and material

**TRAVEL AND FIXED CYCLE TIME COMPUTATION**

**Machine Weight: Empty 37,250 lb; Loaded 75,008 lb**

| Haul Section | Distance (Ft) | RR (%) | GR (%) | Total RR+GR % | Pull Req'd to overcome GR+RR (lbs) | Altitude Correction (%) | Total Pull Required, (lbs) | Traction Limitation (lbs) | Maximum Possible Speed (MPH) | Speed Factor | Average Speed (MPH) | Travel Time (Min.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,512 | 2 | +12 | 14 | 10,501 | – | 11,627 | 37,054 | 6.52 | .65 | 4.24 | 4.05 |
| 2 | 1,512 | 2 | -12 | 10 | — | – | — | — | 30.47 | .65 | 19.80 | .87 |
| | | | | | | | | | | Total Travel Time | | 4.92 |

FIXED TIME: (Spotting, Loading, Turning, Dumping, etc.) 3.80 Min.
TOTAL CYCLE TIME 8.72 Min.

**UPHILL** travel time is almost five times downhill travel time. Fixed time is only about one minute less than travel time.

**Table 1. In-Bank Correction Factors for Various Materials and In-Bank Weights Per Cubic Yard**

| Material | Approx. In-bank weight (lb per cu yd) | Approx. In-bank correction factors |
|---|---|---|
| Bauxite | 2,700–4,325 | .75 |
| Clay, dry | 2,300 | .85 |
| Clay, light | 2,800 | .82 |
| Clay, wet | 3,000 | .80 |
| Copper ore | 3,800 | .74 |
| Earth, dry | 2,800 | .85 |
| Earth, wet | 3,370 | .85 |
| Earth, with sand and gravel | 3,100 | .90 |
| Gravel, dry | 3,250 | .89 |
| Gravel, wet | 3,600 | .88 |
| Granite | 4,500 | .67–.56 |
| Iron ore, hematite | 6,500–8,700 | .45 |
| Limestone, blasted | 4,200 | .60–.57 |
| Rock & Stone, crushed | 3,240–3,920 | .74 |
| Sand, dry | 3,250 | .89 |
| Sand, wet | 3,600 | .88 |
| Shale, soft rock | 3,000 | .75 |
| Slate | 4,590–4,860 | .77 |
| Trap rock | 5,075 | .67 |

**NOTE:** Whenever dirt loads are obtained by shovel, dragline or elevating grader, they will usually be less dense and weigh less than loads obtained by the boiling action of Payscrapers or tractor-drawn scrapers. To compensate for this difference, when top loading multiply applicable in-bank correction factors by .90 for sandy soils, .80 for average soils and .70 for clay soils.

handling are encountered. Production determines the number and types of machines required and the related cost factors.

## E

The efficiency hour (E) accounts for unavoidable time delays such as machine adjustment, lubrication, cable changes, stops made by the operator, shovel moves, blasting, detour traffic, haul road maintenance, and unbalance of "helper" equipment such as motor graders, rollers and pushers.

Crawler equipment will normally operate at the rate of 50 minutes of work time out of each 60-minute hour or at 83% efficiency. Rubber-tired hauling units will normally operate at the rate of 45 minutes of work time out of each hour, or at 75% efficiency. However, under excellent conditions a 55-minute hour (92% efficiency) can be obtained for crawlers and a 50-minute hour (83% efficiency) for rubber-tired equipment. On the other hand, this efficiency drops to 75% (45-minute hour) for crawlers and 67% (40-minute hour) for rubber-tired equipment operating under unfavorable or night conditions.

## I

The in-bank correction factor (I), or swell, is applied to account for voids present in material disturbed by digging or loading. Wet clay, for example, will normally swell 25% when loaded. Table 1 shows the in-bank correction factors for some materials encountered in mining.

## H

The heaped capacity (H) of the machine is normally included in specification sheets and is usually known by the operator. Heaped capacity should not be confused with struck capacity or maximum payload ratings.

## C

The cycle time (C) is the time required for a machine to obtain its load, move it to the place of dump and return to the loading point. Total cycle time is the sum of travel time factors and fixed time factors. Fixed time factors are spotting, loading, turning, dumping and reversing the direction of travel. Travel time factors are altitude, machine weight, rolling resistance, grade resistance, coefficient of traction and average speeds.

The fixed time factors for a truck are summarized in Table 2. The time necessary to load the truck may be estimated from Table 3 and calculated by the formula:

$$\text{Time to load machine} = \frac{\text{machine capacity in cu bank yd}}{\text{loading unit production in cu bank yd per minute}}$$

**Table 2. Fixed Time Factors for Truck**

| | |
|---|---|
| **Spotting** | Depends on number of hauling units per loading unit. Should not exceed .50 min.; usually is not less than .15 min. |
| **Loading** | See Table 3 |
| **Turning** | Not applicable (Time required included in Shovel Spotting and Dumping time) |
| **Dumping** | Depends on whether material is dumped over fill, windrowed (Paywagons) or into grizzly. Bottom Dump—.25 to 1 min. Rear Dump—.50 to 1.50 min. |
| **Reversing Direction of Travel per Cycle** | Not applicable (Time required included in Shovel Spotting and Dumping time) |

Travel time factors offer more variables and depend strictly on the conditions at any one place. The basic formula, without modification, is:

$$\text{Travel time (in minutes)} = \frac{\text{Distance}}{\text{mph} \times 88}$$

However, the following factors retard the mph rate:

**Altitude.** For machines with naturally aspirated engines (not turbocharged), derate lb pull as shown on specification sheets 3% for each 1,000 ft altitude above 3,000 ft. For machines with turbocharged engines derate specification sheet pulls 3% for each 1,000 ft altitude above 5,000 ft.

(*Continued*)

**Table 3. Shovel Output (In-bank cu yd per min.)**

60 min. hr—90° swing

| Dipper Cap., in Cu Yd | ¾ | 1 | 1¼ | 1½ | 1¾ | 2 | 2½ | 2¾ | 3 | 3½ | 4 | 4½ | 5 | 5½ | 6 | 6½ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Moist loam or light sandy clay | 2.75 | 3.42 | 4.17 | 4.75 | 5.34 | 5.93 | 6.76 | 7.27 | 7.75 | 8.75 | 9.68 | 10.6 | 11.4 | 12.3 | 13.2 | 14.0 |
| Sand and gravel | 2.54 | 3.34 | 3.83 | 4.50 | 5.00 | 5.56 | 6.50 | 7.00 | 7.50 | 8.92 | 9.26 | 10.0 | 10.8 | 11.6 | 12.3 | 13.1 |
| Good common earth | 2.25 | 2.92 | 3.50 | 4.00 | 4.50 | 5.00 | 5.73 | 6.34 | 6.76 | 7.58 | 8.50 | 9.34 | 10.1 | 10.8 | 11.4 | 12.1 |
| Clay hard tough | 1.83 | 2.42 | 3.00 | 3.50 | 3.92 | 4.42 | 5.17 | 5.58 | 6.00 | 6.76 | 7.50 | 8.16 | 8.84 | 9.50 | 10.1 | 10.7 |
| Rock, well blasted | 1.58 | 2.08 | 2.54 | 3.00 | 3.42 | 3.83 | 4.59 | 5.00 | 5.34 | 6.08 | 6.83 | 7.58 | 8.33 | 9.00 | 9.58 | 10.2 |
| Common excav. with rocks and roots | 1.33 | 1.75 | 2.17 | 2.54 | 3.00 | 3.34 | 4.08 | 4.50 | 4.83 | 5.58 | 6.34 | 7.00 | 7.68 | 8.33 | 9.00 | 9.58 |
| Clay, wet sticky | 1.17 | 1.58 | 2.00 | 2.42 | 2.75 | 3.09 | 3.83 | 4.17 | 4.50 | 5.17 | 5.75 | 6.42 | 7.00 | 7.58 | 8.16 | 8.68 |
| Rock, poorly blasted | .83 | 1.25 | 1.58 | 1.94 | 2.33 | 2.67 | 3.25 | 3.59 | 3.72 | 4.50 | 5.08 | 5.67 | 6.25 | 6.83 | 7.33 | 7.84 |

## FACTORS THAT INCREASE CYCLE TIME

**Table 4. Travel Time Factors**

| Factor | Effect on M.P.H. |
|---|---|
| **Altitude** | Reduces available pull power which may require lower gear speeds than at sea level. |
| **Machine Weight** | Increasing machine weight by loading requires lower gear travel speeds. |
| **Rolling Resistance** | The higher the rolling resistance the lower the gear range which must be used. |
| **Grade Resistance** | The steeper the adverse grade the lower the gear range which must be used. |
| **Coefficient of Traction** | May eliminate travel in selected gear range if slippage results |
| **Average Speeds** | Maximum possible speeds should be reduced to average speeds. |

**Machine Weight.** Empty machine operating weights are shown on specification sheets. Loaded machine weights can be found by use of the formula

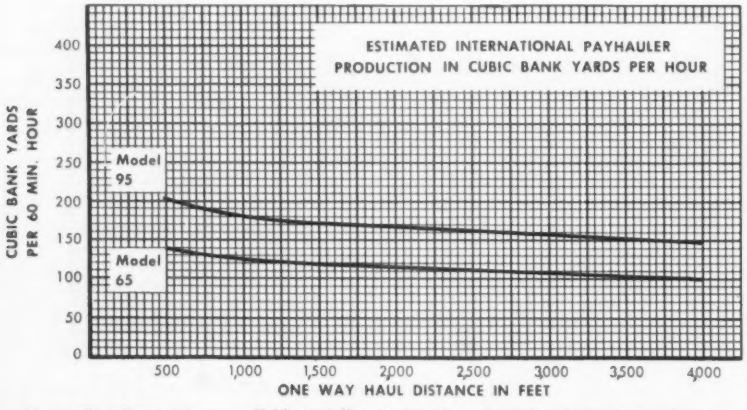
loaded machine weight = (machine heaped capacity, cu yd) × (in-bank correction factor)

(in-bank weight of material, lb) + (empty machine weight, lb)

**Rolling Resistance. (RR)** The sum of the forces which resist forward motion of a machine is its rolling resistance. They include ground conditions, tire flexing and power train friction. The sum of these resistances is expressed in lb as a percentage of machine weight. It is generally found that to overcome such resistances as normal tire flexing and power train friction will require pull power equal to 2% of a machine's total weight. Resistance offered by ground conditions, however, will increase this figure to as much as 16% of the machine's total weight depending on the softness or irregularities of the surface to be traveled. Table 5 lists some of the conditions and resistances encountered in operations.

**Table 5. Rolling Resistance and Coefficient of Traction Factors**

| Type of Haul Road Surface | Rolling Resistance (% Machine Total Weight) | | Coefficient of Traction, (% of Machine Weight on Drive Components) | |
|---|---|---|---|---|
| | Rubber-Tired Machines | Crawler Tractor | Drive Tires | Crawler Tracks |
| Concrete, rough and dry | 2% | — | .80–1.00 | .40–.50 |
| Compacted dirt and gravel, well maintained, no tire penetration | 2% | — | .50–.70 | .80–.90 |
| Dry dirt, fairly compacted, slight tire penetration | 3% | — | .45–.65 | .80–.90 |
| Firm, rutted dirt, tire penetration approx. 2 in | 5% | 2% | .40–.50 | .70–.80 |
| Soft dirt fills, tire penetration approx. 4 in | 8% | 4% | .40–.50 | .70–.80 |
| Loose sand or gravel | 10% | 5% | .20–.30 | .30–.40 |
| Deeply rutted dirt, spongy base, tire penetration approx. 8 in | 16% | 7% | .10–.20 | .30–.40 |




**E = 60 minutes;** I = well-blasted limestone; C = level haul plus 3.8 minutes.

**Table 6. Factors for Converting Maximum Hauling Unit Speeds to Average Speeds**

| Haul Section Distance in Ft | Speed Factor |
|---|---|
| 500–1,000 | .46–.78 |
| 1,000–1,500 | .59–.82 |
| 1,500–2,000 | .65–.82 |
| 2,000–2,500 | .69–.83 |
| 2,500–3,000 | .73–.83 |
| 3,000–3,500 | .75–.84 |
| 3,500–4,000 | .77–.85 |

Rim pull (RP) or drawbar pull (DBP) required to overcome rolling resistance (RR) may be found by use of the formula:

RP or DBP required to overcome RR = total machine weight, lb × RR Factor

**Grade Resistance. (GR)** For each 1% of adverse grade, the machine must develop an additional pull equivalent to 1% of the machine's total weight in lb. This is expressed by the formula:

RP or DBP required to overcome GR = total machine weight × GR in %

**Coefficient of Traction.** Table 5 shows the percentage of weight on tracks or drive tires which can be utilized as pull power on various ground surfaces before slippage occurs. A traction check may be made by use of the formula:

Usable RP or DBP before slippage = (machine weight on tracks or drive tires) × (coefficient of traction factor)

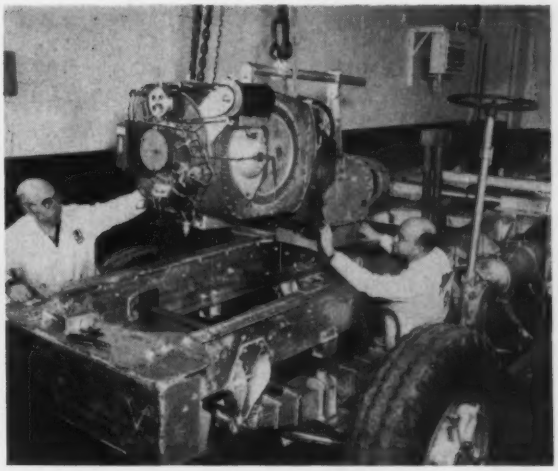
**Average Speeds for Rubber-tired Hauling Units.** In order to adjust maximum attainable speeds to estimated average speeds, the speed factors shown in Table 6 can be used to advantage. Maximum speeds may be converted to average speeds by use of the formula:

Average speeds = maximum speeds × speed factor

To estimate total travel time, it is necessary to break the haul road into sections wherever grade, rolling resistance, or both change. Then apply the travel time formula to each haul road section. The total of the time spent on each section is the total travel time.

Finally, the above data may be summarized and a production vs distance graph prepared for all items of equipment considered for any particular job. From this, the type and number of units necessary can be quickly and efficiently determined.

**THE 75-TON** electric truck receives power from a trolley and an ac-dc Cummins generator under the hood.



**GAS TURBINE ENGINE,** the GMT-305 Whirlfire, delivers more usable hp than reciprocating engine for same installed hp.

**THE 55-TON "Lectra Haul"** is powered by four electric wheels that receive electricity from a turbodiesel engine.

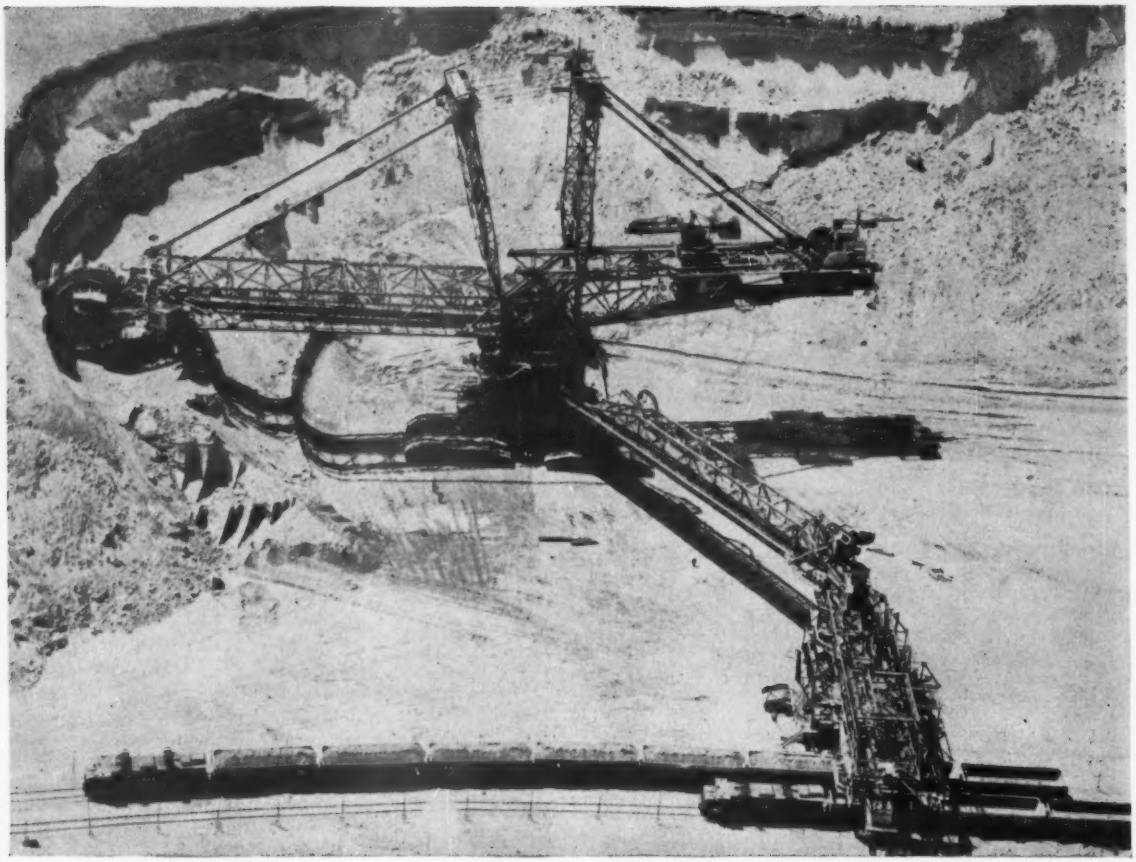
**LECTRA HAUL** can negotiate 15% grades; it has no transmission, axles or gear shift and can reduce haulage costs by 30%.

**WAGON TRAINS ON RUBBER** are designed for on- or off-highway use and come in a variety of engine and body sizes.

## Four New Trucks

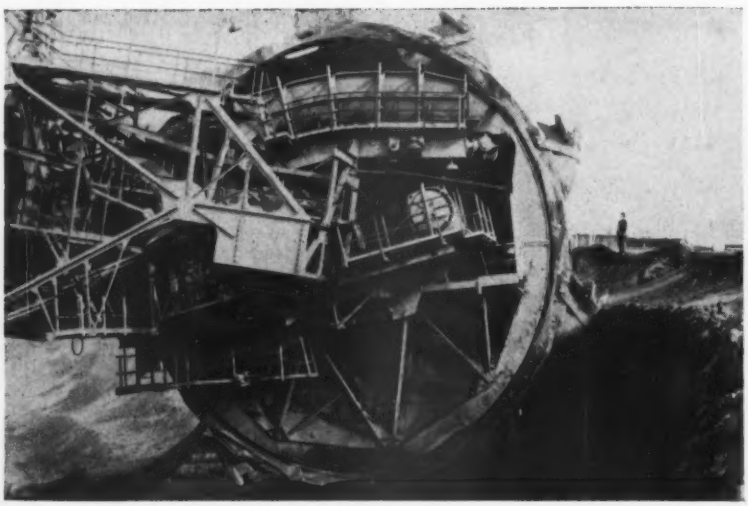
LEADING THE WAY to better truck haulage are the four new trucks illustrated on this page. The trolley truck is in operation at Anaconda's Berkeley Pit uses four 400-hp electric wheels. The Allison gas turbine engine is being installed on trucks at the Sudbury District operations at International Nickel Co. of Canada Ltd. Unit Rig & Equipment Co. has developed the Lectra Haul and demonstrated its great maneuverability and rapid stopping features. The Wagon Train on Rubber is a development of Differential Co.

Then there is the 13-car truck train with gas turbine generators and electric wheels currently being developed by the U.S. Army. (See E&MJ, April 1960.)



**AT THE FORTUNA MINE** of Western Germany, one of the world's largest bucket wheel excavators loads into railroad cars on parallel tracks. The machine can selectively mine different strata and simultaneously create a level haulage face.

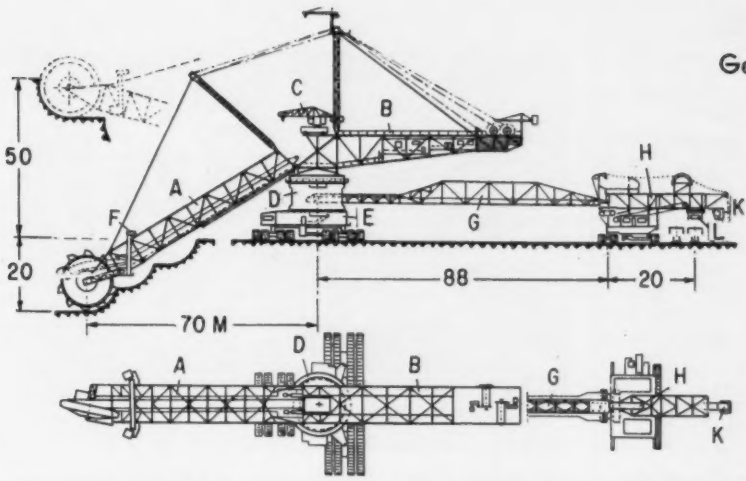
# Huge Machines Mine Continuously



**THIS WHEEL** is capable of digging 13,000 cu yd per hour. Note man at right.

DIMENSIONS AND OUTPUT FIGURES of the bucket wheel excavator are making impressions in international mining circles. Recent design improvements have allowed increased output and lowered machine weight, and have made possible the excavation of harder materials. For example, one machine, built by Orenstein-Koppel und Lubecker Maschinenbau Aktiengesellschaft (LMG), has a total service weight of 6,790 tons and can excavate up to 10,500 cu m per hour. The excavators' value lies in stripping overburden or excavating soft materials such as coal, loose ores, borax, soft iron-ores and phosphate. Consolidated sandstone, requiring light blasting, has been excavated by a machine in India. (See E&MJ, January 1960, for a case history at Nchanga.)

Chief advantages of the bucket wheel excavator are: (1) Working maximum heights and leaving flat slopes to avoid earth-slides (up to




**EXCAVATOR DESIGN** permits digging above and below track level. The flexible conveying system allows the machine to work on levels different from the haulage level. Material can be loaded directly on belt conveyors or in cars or trucks.

## Sandwich conveyor

### General arrangement of excavator:

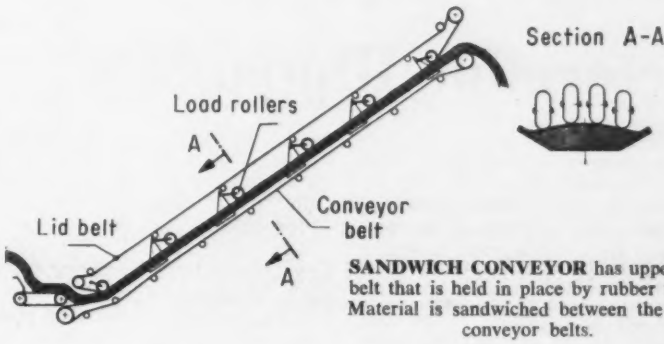
a) Bucket wheel boom which can be raised and lowered
b) Superstructure with machinery houses, ballast and winches
c) Mobile assembly crane, hook load with an outreach of 8 m (26 ft) = 15 tons, with an outreach of 12 m (39 ft) = 10 tons
d) Slewable central unit of excavator between two ball races, with telescoping arrangement and support of bridging conveyor
e) Undercarriage with crawler travel gear, control equipment, cabins for switch gear, workshop and crew
f) Operator's cabins which can be lifted and lowered
g) Bridging conveyor
h) Loading plant
k) Belt attendant's cabin
l) Reversible discharge belt

36%); (2) Clear selective winning of different strata and simultaneous creation of a level face for haulage purposes; (3) Continuous loading of high outputs into trains or onto conveyor belts (no spilling); (4) The excavator may work on levels different from the haulage level — provision can be made to make excavator work and travel on gradients of up to 1:6; (5) Bucket wheel without cells and steep conveyor in bucket wheel boom make high or deep cuts possible at will; and (6) Conveying of stony spoil is possible, thanks to a rotary feeding plate on the bucket wheel.

The bucket wheel excavator is essentially a crawler-mounted self-propelled machine with a digger which consists of a large vertical wheel with steel buckets mounted on the periphery. The wheel is mounted on a boom which permits it to be raised or lowered; on some models the boom can also be thrust forward and retracted. A receiving belt conveyor delivers to a loading belt conveyor on the excavator which in turn discharges material onto belt conveyors or into cars or trucks.

Bucket wheel diameters range from 8 to 52 ft. The largest units built to date have a maximum cutting depth of 66 ft and maximum cutting height of 164 ft from a single bench. The reach of the bucket wheels on the machine is 302 ft., and the reach of the loading belt conveyors is 121 ft. The largest bucket wheel excavators can work blocks 100 to 300 ft in width.

Three major factors determine the justification for utilizing the bucket wheel excavator and belt conveyor system.




**SANDWICH CONVEYOR** has upper lid belt that is held in place by rubber tires. Material is sandwiched between the two conveyor belts.

**1.** Satisfactory amortization of the capital investment for these installations and minimum over-all production costs require an assured life for the open-pit operation plus an assured annual tonnage at relatively continuous, full capacity operation.

**2.** Materials to be excavated must be within the digging limitations of the bucket wheel excavator. For each project a careful study of the material is necessary.

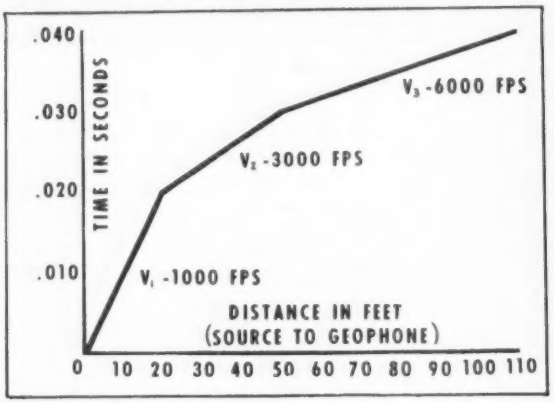
**3.** The method of mining and the deployment of equipment must be planned for the life of the entire operation. Basically, an ideal operation should cover a wide, fairly level area where the material to be dug is of substantial depth. The most economical methods can be developed where each stratum is well defined and of the same consistency. However, on occasion the wheel has selectively excavated material from the same layer.

An important consideration in preliminary planning is the method or combination of methods to be used for advancing multiple working faces most effectively and economically. It is possible to work faces 6,000 ft in length with a shiftable field belt conveyor on the bench to transport the material to relatively stationary conveyors from which the material is delivered to the disposal area by another shiftable conveyor and stacker belt conveyor. Each project requires careful study to reduce to a minimum the time required for shifting and deploying the conveyors.

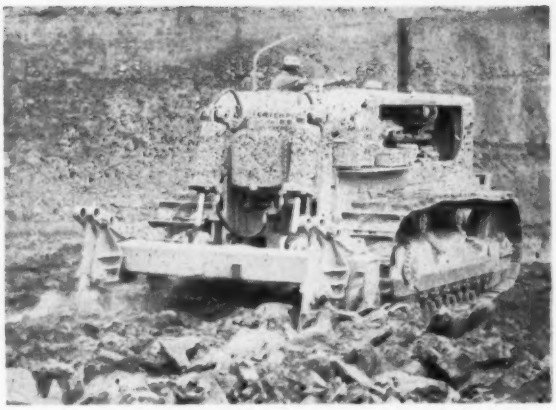
The wheel control room of the bucket wheel excavator contains banks of instruments to indicate various functions with clear, specific warning ranges, and in some cases are designed to automatically start a shutdown sequence when pre-determined limits are reached.

Conveyor systems for use with the bucket wheel excavator are engineered for the particular material, capacity and other physical requirements of the installation.

Bucket wheel excavators are being introduced in the U.S. by Link-Belt Co., who has acquired sale rights to the LMG models.




**THE STEEPER** the line, the better the rippability. A change in slope indicates a change in velocity and consolidation.



**BLASTING IS AVOIDED** by ripper that makes progressively deeper cuts. Costs are 12 to 60% of those for blasting.

# Using Seismics to Determine Rippability

UNTIL RECENT YEARS, hard or rocky materials could be moved only by blasting followed by shovels. Now, rippers on crawler tractors are in common use for shattering and loosening tough materials prior to scraper loading.

The key to rippability is the consolidation of the material, but core drilling and electrical resistivity methods to test it are expensive and time-consuming. Caterpillar Tractor Co. engineers have developed a fast, inexpensive and accurate way to learn if a material can be ripped. The method relates the speed of sound waves traveling through different materials to the degree of compaction of those materials.

The equipment used is light-weight, easy to operate and accurate. It includes a source of shock wave (an 8-lb hammer and a small steel plate), a receiver (a standard geophone) and an electronic counter. It all weighs about 40-lb and costs less than $3,000.

The electric counter operates on self-contained batteries. A geophone plugs into a jack on the counter's face. Another wire connects the counter with an impact switch on the steel plate. When the plate is struck by the hammer, the blow is registered by the counter. When the first ground-transmitted wave reaches the counter through the geophone, the counter is stopped. The time difference in milliseconds is recorded by flashing lights.

The first check is made at, say, 10 ft from the geophone. Successive checks follow at regular measured intervals in a straight line from the geophone. A complete test on an area can be run in less than 30 minutes. Assuming that wave velocities for topsoil, weathered rock, and bedrock are 1,000, 3,000 and 6,000 fps, respectively, it can be understood that seismic waves traveling longer paths can reach the geophone first. (See graph at top of page.) Points plotted on a graph fall in line for each type of material as long as the consolidation is the same. A change in slope indicates a change in velocity and consolidation.

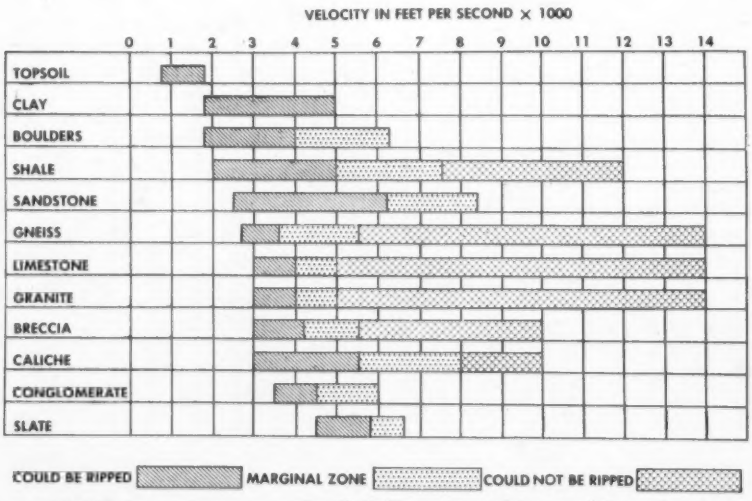
The depth of a particular strata can be found by the formula,

$$D = \frac{x}{2}\sqrt{\frac{V_2 - V_1}{V_2 + V_1}}$$

where D is depth, X is the distance from the geophone to the point of the first velocity change, $V_1$ is the velocity of the wave in the upper layer, and $V_2$ is the velocity in the next lower layer. Depths of successive layers are determined in similar manner.

Where material is rippable, costs are likely to range anywhere from 12 to 60% of those for blasting and shovel loading.

Caterpillar has condensed information from a large number of tests into a set of graphs. As in the chart to the left, a separate graph must be made for each size of ripper.




**A CHART** for a ripper on a Cat D-9 illustrates which material can be ripped. Treatment of marginal zones vary with the operator and his experience.

# Nuclear Blasting Needs More Study

"EVEN WHEN NUCLEAR BLASTS can be detonated, we cannot experiment with actual orebodies until we know much more about what we will be doing. These orebodies are costly to find and constitute the basic wealth of our nation . . . Hurried, unplanned decisions to set off one of these devices will not obtain for us the full benefit of the money spent, and all too frequently disappointing results can put off the day when we will be able to harness this powerful tool in the interests of the nation."

These are the words of James Boyd, former vice president (exploration) for Kennecott Copper Corp. and newly-elected president of Copper Range Co. Boyd put a mild damper on nuclear blast enthusiasm in a talk prepared for the Joint Congressional Committee on Atomic Energy. In cautioning the Congressmen, Boyd listed specific problems likely to be encountered by nuclear blasting. An abstract of his remarks follows.

"Through the efforts of the Congress, the Executive Branch and the various industries involved over the past few years, there is virtually no mineral, raw material or fuel that is not in ample supply to meet the voracious needs of the entire Free World's industrial economy as it stands today. The problems that are brought to Congress in these areas are the result of over-capacity to produce—not shortages.

"The theories as to how we can break rock by the use of atomic energy revolve mainly around the use of explosive devices, because the breaking of rock is the important step in mining—both in removing the overburden and in mining the ore itself. It is not just a matter of breaking the rock, but breaking it so that the fragments can be readily handled and hauled to the mill. Briefly, the problem is whether or not nuclear blasts can do this more economically than conventional methods, yet safely and without contaminating or diluting the orebodies.

"Some of these ideas, such as breaking ore to be handled subsequently by conventional methods, might result in a minor but important economy. Others, such as instantaneously blowing all of the overburden off a buried deposit, would be revolutionary changes."

In discussing cratering, Boyd raised these questions. "If a crater were made with nuclear explosives, how much "over-break" would there be? How much would it cost to clean up the crater so that mining could proceed below it? Would the slope of the crater walls be stable? If the nuclear device were placed below the crater floor, would there be a forbidden, radioactive zone created within the ore itself? If so, how extensive would it be? These and other questions come to mind, but firm answers are not yet available."

In discussing the breaking of the ore, Boyd brought out these points. "If the waste and ore were broken, mixed and piled up together, the mixture would be uneconomical to treat. In other words, there would be no ore. If, as a result of a nuclear blast, there were many pieces too large to handle with available equipment, there would be an excessive amount of expensive secondary drilling and blasting required."

In dealing with costs Boyd stated, "In the present practice, drilling and blasting constitute a small, continuing operating charge which is paid from current earnings. The interest charges on the additional investment required to break all the ore at once could be a financial burden throughout the entire life of the mine."

# Deep Sea Mining Nears Reality

JOHN L. MERO is continuing studies of deep sea mining. Last year he made studies on deposits of manganese nodules and outlined economic mining procedure for their recovery. (See E&MJ's June 1959 Guidebook.) This year he is preparing an economic analysis of mining deep-sea phosphorite. The abstract of his paper follows.

The existence of brown-black concretions of tri-calcium phosphate on the sea floor off the coast of California has been known for over 20 years. Commonly called phosphorite nodules, this material is found in high concentrations as a mono-layer of pebbles and boulders at the surface of various non-detrital, topographic environments of the California borderland area. The nodules range in size from oolites to boulders over 3 ft in diameter.

Drag dredging is a semi-proved technology and has been used by oceanographers for over 85 years to recover ocean bottom sediment samples from water as deep as 25,000 ft. The mining cost indicated by this method of mining in water 600 ft deep, which is the average depth of water over Forty Mile Bank, is $4.50 per ton of ore.

Hydraulic dredging as proposed in this report has not been tried on a commercial basis in depths of water greater than 150 ft. The method is technically feasible, and while mining cost estimates are about the same as drag dredging for a 400,000 tpy production rate, the cost of this method of mining drops markedly as tonnage increases. Also the depth of dredging with a hydraulic dredge does not influence the mining cost to any great degree for conventional installations.

The indicated capital investments of a drag dredging system of mining to produce 400,000 tpy of ore are indicated to be about $3.5 million, while the capital cost of a hydraulic dredging unit would be about $4.5 million. The yearly return on the capital invested is indicated as 52%, after taxes, for drag dredging and as 39%, after taxes, for hydraulic dredging.

The State of California has no commercial-grade deposits of phosphate rock but imports over 100,000 tons of $P_2O_5$ annually. The cost of the imported phosphate rock at California points is as high as $15 per ton, 50% of the total cost being freight. Phosphate rock is used primarily as a source of phosphate in the manufacture of chemical fertilizer. Because of the slight transportation costs involved in mining and marketing the off-shore phosphorite, these deposits may be commercial to mine for the California market.

The off-shore phosphorite averages about 29% $P_2O_5$ and estimates of the total tonnage available for mining in the California Borderland area range into the hundreds of millions of tons. Calcining the nodules will upgrade them to about 32% $P_2O_5$.

One deposit in particular, the Forty Mile Bank deposit which lies about 40 miles due west of San Diego, appears favorable from a mining standpoint. Sufficient data were available to make concentration estimates and other engineering measurements necessary to design a mining method of the phosphorite nodules in this deposit. Dredging is the answer.

# Revolution in Power

INTENSIFIED RESEARCH AND DEVELOPMENT programs will unquestionably have a shocking impact on so-called "conventional" methods of generating, transmitting and controlling mechanical and electrical power during the decade of the '60's. For instance, page 229 illustrates and describes a new natural-gas engine which is supercharged and aftercooled. It was developed by Caterpillar Tractor Co. for low first cost and economical operating cost. This is but one product of the company's research and development program which last year involved expenditures of about $37-million. An appreciable part of this total was spent on the improvement of engine designs.

Nearly every major electrical manufacturing company is pushing programs for the development of "unconventional" methods of generating electrical power such as the fuel cell, thermoelectricity, thermionic conversion in addition to considerable projects in fission and fusion. Even such long-standing mechanical links as the gear shift, transmission and differential may become obsolete in some designs. The piston engine may yield to the turbine and electric motor, or possibly to revolutionary new internal combustion engines. (See p. 228.)

## 1. Nuclear Power

DESPITE THE QUESTIONABLE OUTLOOK for the use of uranium after 1966, the mining industry can place faith in the progress that is being made on all fronts in the economic production of nuclear power.

General Electric Co.'s boiling-water reactor was chosen most likely to produce economically competitive power by a panel of seven international nuclear experts set up by the World Bank and Italian Government to help in the selection of the best reactor type for the SENN plant in Italy which will be a 150,000-kw unit. (SENN is the Societa Electronuclear Nazionale.)

The GE boiling-water reactor was also chosen for the 180,000-kw unit to be built at Commonwealth Edison Co.'s Dresden nuclear power station in Illinois. (See illustration.) This will be completed soon.

A third GE boiling-water reactor plant built for Pacific Gas & Electric Co. near Eureka, Calif., will produce about 50,000 kw.

Advantages of the boiling-water reactor are as follows:

1. More than $100-million has been invested in developing this reactor because such reactors can become competitive with conventional power, according to GE scientists.

2. Boiling water safety characteristics have been improved.

3. Low-enrichment, uranium-oxide fuels have demonstrated their feasibility for commercial service.

4. Development of the boiling water reactor has been accomplished to the point where no breakthroughs are needed to produce competitive power.

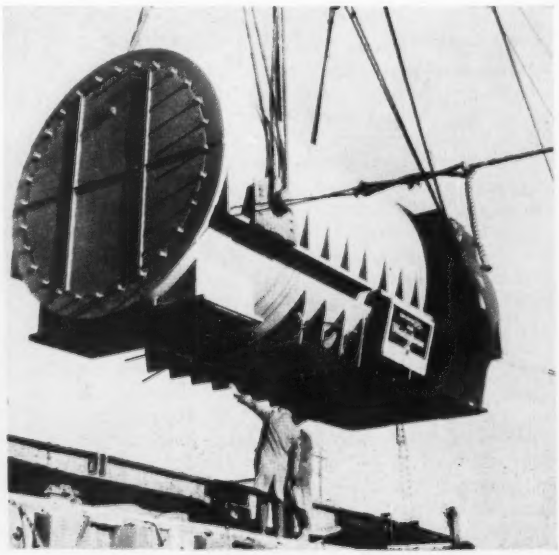
5. Specific technical improvements needed are known by GE's Atomic Power Equipment Department.

### Economic Power from the Atom

Westinghouse engineers, working in cooperation with architectural and engineering firms, have arrived at definite answers on the production of economic power from the atom. The study identified three different nuclear power plant projects as "next logical steps" for utility companies to undertake. In two of these projects, plant output, over-all plant costs and fuel life can be guaranteed.

The three plants are: (1) a 330-mw closed-cycle light water plant; (2) a 225-mw plant, utilizing a nuclear reactor plus fossil-fired superheating; and (3) a 20-mw integral boiling and superheated reactor, within the same reactor

**LARGEST PRIVATELY-FINANCED** nuclear power plant is being built by General Electric for Commonwealth Edison.



**GENERATOR** for Consolidated Edison's 275,000-kw atomic plant at Indian Point, N.Y., is hoisted. Westinghouse unit.

core. The first two plants can have the guaranteed factors indicated above. The third would be a prototype.

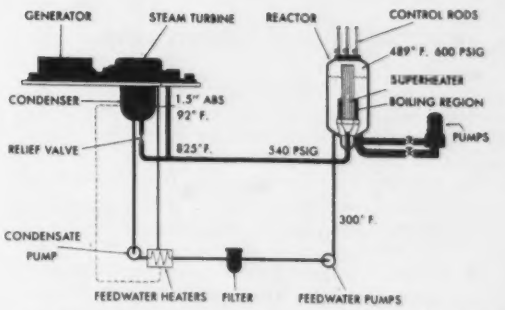
### A Major Breakthrough

Allis-Chalmers Mfg. Co. reports a major breakthrough in atomic power technology in the design of a nuclear superheated integral with the boiling core. Utilizing nuclear superheat, the power reactor will be able to generate steam at 825° F and 525 psi. The higher steam conditions will increase plant efficiency to about 31%, and reduce the moisture problems associated with saturated steam. Increase in plant efficiency is possible because forced circulation greatly reduces void content at the top of the reactor core, resulting in higher power density.

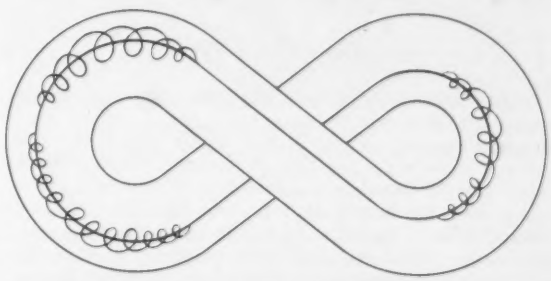
The accompanying drawing shows the Pathfinder nuclear power plant which was designed, and is being built by Allis-Chalmers. It is a 62,000-kwe, direct-cycle, boiling-water reactor situated near Sioux Falls, Iowa. The project is the joint effort of 11 power companies in the midwest area in cooperation with AEC.

### The Outlook 1965-70

In 1965, the nation's operating nuclear-electric generation capacity is expected to exceed 2-million kw, swinging rapidly upward to 12-million kw by 1970. These new generation stations will use nuclear steam systems that are competitive on an economic basis with conventional energy sources.[1]




**NEW 62,000-KW PATHFINDER** nuclear power plant is being built by Allis-Chalmers for 11 power companies in midwest.



**AT THE HIGH TEMPERATURES** of fusion reactions (hundreds of millions of degrees) matter dissociates into ionized particles to form plasma. Researchers are now designing Stellarators, shown above, which will be necessary to contain the plasma in controlled thermonuclear reactions. Spirals indicate path of plasma particles about strong magnetic lines.[3]

## 2. Fusion Power

ABOUT TWO YEARS AGO when the first reports of thermonuclear reactions were publicized, scientists were not sure that an actual fusion reaction had been achieved. But after continued research at Los Alamos and elsewhere, scientists are now firm in their belief that a thermonuclear reaction has been propagated. Dr. James Tuck, in charge of thermonuclear research at Los Alamos, has reported that a small fireball, less than one inch in diameter, has been produced with a temperature of 13-million deg.[2]

At these elevated temperatures, matter dissociates into bare nuclei and electrons. This is plasma. The big problem is to contain plasma to produce useful power. Huge magnetic devices developing tremendous magnetic fields are being designed to contain plasma. Among these are the Stellarator and the magnetic mirror.[3] The Model C Stellarator, now under construction at Princeton, is 25 ft long, and will reach a temperature of 200-million deg K. Scientists and engineers estimate that cost to build a commercial model 500 ft long would be about $200-million. With turbogenerators and auxiliary equipment, the cost would total about $1-billion. Power output would be about 5-million kw.

Scientists frankly admit that even though fusion has been produced, they do not know when, or if ever, commercial power will be produced by fusion. But the goals are so tremendous, that research must go on. Speaking of the inadequacies of fission power, Dr. Milton A. Rothman, research physicist of Princeton University, says, "The supply of uranium in the world is quite finite. Its use will extend our power-producing capabilities for a certain length of time, but ultimately (within hundreds of years) our uranium and thorium will be used up. Secondly, by the time uranium is used to generate a large fraction of our power, the disposal of radioactive waste products will be a major problem. Fusion on the other hand can be derived from the large supply of deuterium in the water of the oceans, and is essentially a 'clean' process, inasmuch as there are no radioactive fission products to dispose of."[3]

### Fusion Facilities under Construction

Research into controlled thermonuclear fusion reactions will be conducted with a new experimental facility being engineered by C Stellarator Associates, a combination of management, engineering and scientific personnel of Allis-Chalmers and RCA. In the Model C Stellarator, a hydrogen isotope will be confined in a racetrack-shaped vessel by a 50,000-gauss magnetic field and heated to temperatures on the order of 100-million deg. At this temperature the kinetic energy of the ionized gases (plasma) will cause colliding nuclei to fuse and release energy that can be used to generate electrical power. Construction of housing for the fusion facilities has been completed, and auxiliary equipment is now being installed.[4] Three main m-g sets, power supply for the magnetic coils, are partially installed. Each set consists of four large dc generators driven by a 7,000-hp motor and a 20-ft dia, 96-ton flywheel which will provide the energy storage necessary for the pulsated operations. Auxiliary m-g sets and motor-control liquid rheostats are also installed.

(*Continued on next page*)

[1] "Five Years of Commercial Atomic Progress—1955-60." A General Electric Co. brochure.
[2] NEW YORK TIMES, March 23, 1960
[3] "The Status of Fusion Power," FOOTE PRINTS, Vol. 31, No. 2, 1960
[4] "Engineering in Action," ALLIS-CHALMERS REVIEW.

## 3. Thermionic Conversion

AN EARLY GOAL of nuclear scientists has been that of converting nuclear energy directly into electricity. That goal has been reached, at least for space vehicles, where light auxiliary power sources are required. General Electric Co. engineers have produced a thermionic converter in which radioactive gold is used to power the device.

For a small satellite model, the piece of gold is 1/16 in. thick, 4 in. wide and 6 in. long. Sherman Naymark, in charge of GE's nuclear energy conversion project, says that a power pack producing more than 100 watts of electricity and lasting more than a year could weigh less than 25 lb. Cerium 144 is another auxiliary space-craft power.

## 4. Thermoelectric Power

MORE THAN 1,000 COMPANIES are working on various phases of electronic heating and cooling—based on a principle known as the Peltier effect which was discovered many years ago. The Peltier effect is simply this: when certain materials (combinations of metals or semiconductors) are heated, they produce electricity (thermoelectric power). This is the principle of the thermocouple. Conversely when electricity is directed through certain semiconductors, the material becomes a "heat sink"—absorbs heat. Recent discoveries in the field of electronic heating and cooling have been so startling, that business magazines predict an imminent revolution in design of equipment used in refrigerators, air conditioners, electrical appliances, automobiles and other major industries including that of power generation.

RCA and other companies have built experimental or demonstration models of units which can be used to refrigerate foods by passing electric current through a semiconductor element in one direction. The same unit can be used to cook food by passing current through the semiconductor element in the opposite direction. Designers are already working on units or panels that will be used to heat or cool homes (true air conditioning). It is conceivable that within a decade, conventional refrigerators and air conditioners will become obsolete. Not the least, are expectations that the direct production of electricity from heat—by passing the boiler and steam generation phase—will become commercially available in some applications.

### High-Purity Metals Speed Development

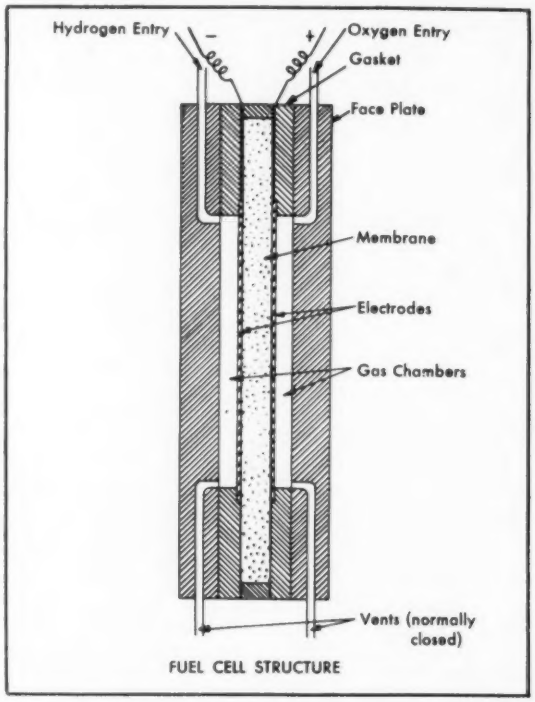
As in all semiconductor applications such as the transistor, etc., the production of high-purity metals, of the order of 99.999% pure and better, at economic prices is essential. Fortunately, the long-range research programs of American Smelting & Refining Co. and others have made it possible to produce ultra-high-purity metals at economic prices.

Westinghouse research laboratories have developed a thermoelectric material—the most efficient of its type yet discovered—for use in high-temperature range from 850 to 1500° F. This top temperature is well above the melting point of aluminum, magnesium and many common thermoelectric materials. The new semiconductor material is a compound known as indium arsenide phosphide, prepared by combining high-purity indium with equally pure arsenic and phosphorus.

Recently Westinghouse announced that it has received a contract from the U.S. Navy to design, construct and test a 5,000-watt thermoelectric generator. The heat source will be a fuel readily available to the Navy—probably diesel oil or fuel oil.

Thermoelectric power generation requires that a difference in temperature be maintained across the thermoelectric materials, which when heated, produce electricity. Ordinary sea water will be used directly, if possible, although fresh water, cooled by sea water in a heat exchanger, will be used in the unit if necessary.

Another thermoelectric device to be built for the Navy will be an experimental unit that combines into one system a thermoelectric air conditioner, space heater and a refrigerator freezer. The Navy will use the experimental system to test suitability of electricity for air conditioning and refrigeration on ships.




FUEL CELL STRUCTURE

**SECTION THROUGH** 3-in. dia disk shows gas chambers separated by membrane. The hydrogen molecules break up into electrons and positively-charged hydrogen. Flow of electrons through the electrodes produces current in external circuit.

## 5. The Fuel Cell

FOR MORE THAN 100 YEARS scientists have been searching for a method of using conventional fuels to produce electricity directly from a chemical reaction without boilers, turbines and generators in conventional power plants. It now appears that this goal is within sight. More than a dozen major companies are working rapidly toward the development of commercial models of a unit called the fuel cell which might replace certain types of conventional electrical power generating equipment—and even replace the piston engine in the automobile.

Even though the fuel cell has been known since 1839, when it was first described by W. R. Grove, the subject has been virtually dormant. During the last few years, research on the fuel cell has been so intense that it is

being suggested as an energy source for everything from electric automobiles to space ships.[5]

Dr. Guy Suits, of General Electric, said, "The fuel cell may find both civilian and military uses, despite the fact that it produces low-voltage direct current. We cannot yet determine how competitive it will be with other power sources, but its special characteristics may well fit it for a variety of uses. It is likely that the present cell will be useful for specialty applications, rather than for the production of large quantities of power for general purposes."

In military applications, the fuel cell might replace any battery or generator set now in use, because it is light, compact and potentially could operate on conventional fuels.

The fuel cell, illustrated here, can be regarded as a battery. This type was developed by Dr. W. T. Grubb and Dr. Leonard Niedrach of GE's laboratories. It consists of a round plastic disk about one-half inch thick and three inches in diameter. Its hollow interior is divided into two chambers by a special plastic membrane, which has an electrode in contact with each of its two sides. Hydrogen is fed into one chamber and oxygen into the other, or oxygen in the air can be used.

At one electrode, the hydrogen molecules break up into electrons and positively-charged hydrogen. The electrons travel through an external circuit to the other electrode, thus creating an electric current. The positively charged hydrogen moves through the membrane, which has an electrode in contact with each of its sides.

In conventional fuel cells, an electrolyte is used between the electrodes. In the GE model shown here the ion exchange membrane serves as the electrolyte. This is better than aqueous electrolytes because the electrolytically conducting ions are "locked in" and cannot be leached from the cell. These membranes also reject water when they reach saturation, and therefore do not suffer from dilution effects.

The cell operates efficiently at normal atmospheric pressure. Thermal efficiencies of more than 60% have been obtained. One test cell has been operating continuously at the GE laboratory for more than seven months.

## Fuel-Cell Powered Tractor

Allis-Chalmers Mfg. Co. demonstrated a tractor powered by a fuel cell in October 1959. The research vehicle develops at least a 3,000-lb drawbar pull, enough to pull a multiple-bottom plow. Although the experimental fuel cell tractor is of commercial size it is regarded by A-C as a research vehicle. (See illustration.)

Electricity that drives the tractor comes from 1,008 individual fuel cells. These are joined in 112 units of nine cells each. The 112 units are arranged in four banks and electricity can be taken from any combination of the banks. A mixture of gases, largely propane, fuels the cells. The gases are fed into the cells through a system of tubing and, once in the cells, the gases react in the electrolyte. A catalyst coating the electrodes of each cell aids the reaction.

Chemical reactions within the cells cause a direct current to flow through an external circuit which is connected by bus bar to a standard controller, which regulates the electricity supplied to a 20-hp dc motor.

The controller permits the tractor driver to regulate speed or reverse the tractor's direction by moving two levers. Using the speed control, the operator places the four banks of cells in series or parallel, varying the amount of current going to the motor. To reverse the tractor, the driver moves the second lever, changing polarity of the current flowing to the motor.

**FUEL, LARGELY PROPANE,** flows through 1,008 individual fuel cells to produce dc electricity which powers a 20-hp electric motor driving the tractor.

Allis-Chalmers reports that engineers see in the fuel cell a valuable energy conversion method through use of off-peak generator facilities to produce hydrogen and oxygen which can be stored, transported and utilized at will in fuel cells. Low-voltage constant loads of such electrochemical processes as plating, water purification, galvanizing, electrolytic cleaning and electrolytic refining of metals could make use of this type of energy.

When the free energy of the reaction is converted directly into electric energy, as in the fuel cell, there are no theoretical limitations on efficiency. The possibility of producing electric power directly from a fuel at an efficiency of 90% is truly startling when compared to the best diesel engines, which are about 40% efficient.

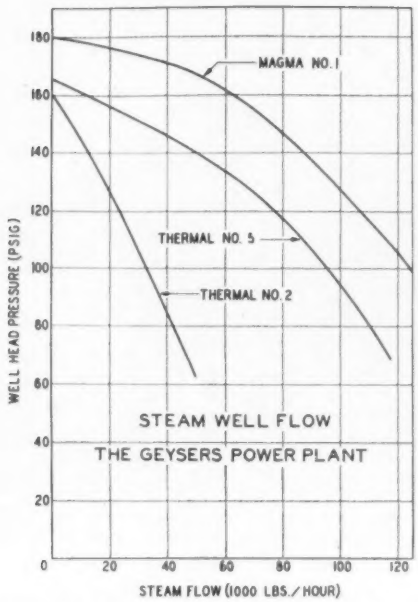
## In the Automobile

Dr. C. R. Lewis, in charge of fuel-cell research at Chrysler Corp., says that in its present stage of development, cells are not ready for use in automobiles, and probably will not be for several years. In fact he looks for turbine development to be the next step in automotive power plants, and fuel cells may follow that. But, Dr. Lewis said, fuel cells can be applied today to railroad cars, small trucks and tractors where restrictions are not so critical and where regular programs of maintenance are practiced.

Present cells are too heavy and too large for automotive installation by a factor of 4. Only cells which operate under high pressure and at high temperatures can produce enough power today to operate cars.

Possible fuels include liquid hydrogen and hydrides as a source for hydrogen. But the most attractive method of adding fuel seems to be the introduction of hydrocarbons directly into the cell for catalytic decomposition. This can be done at high temperatures now. The problem is to speed up the reaction at low temperatures. Straight hydrocarbons, any combination of hydrogen and carbon, like gasoline, are not adaptable thermodynamically. Partly decomposed hydrocarbons, such as alcohol, seem more likely to supply the answer to fuel problems.

[5] General Electric Research Laboratory Bulletin, 1959-60.




**STEAM WELL-FLOW CHARACTERISTICS** indicating available power which will be harnessed at The Geysers, Calif.

## 6. The Geothermal Power[6]

THE USE OF NATURAL STEAM to produce electric power has been found feasible in five areas of the world: Italy, New Zealand, Russia, Mexico and The Geysers, Calif. Although the amount of power which The Geysers power plant will produce is small compared to the power produced in Italy and New Zealand, rapid development of the present producing site and active exploration in the state may well change this picture in the near future. Recent volcanism and faulting, which are responsible for the occurrence of natural steam, have played a major role in the geologic history of the West Coast.

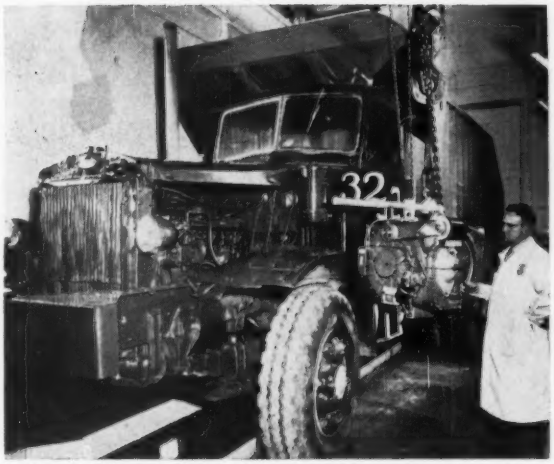
The accompanying graph shows steam flow-wellhead pressure from measurements made in July and August 1958, at The Geysers, approximately 30 miles north of Santa Rosa, Calif.

Steam produced at The Geysers has two desirable characteristics for use in a turbine: (a) it has a comparatively low content of noncondensable gases, and (b) it is superheated. A plant, scheduled for operation in mid-1960, will have an output of 12,500 kw. The electrical energy produced at the power plant will be fed into the Pacific Gas and Electric Co. system over a new 60-kw transmission tap which will tie into the existing 60-kw circuit approximately 10 miles from the plant.

The turbine for the plant at The Geysers is designed for 100 psig. and 348° F inlet steam conditions, which amounts to approximately 11° superheat. Superheated steam is also more desirable because it contains more heat energy than saturated steam, and therefore will produce more power at the same pressure.

After Pacific Gas & Electric Co. had received authorization from California in 1959, additional test holes ranging from 800 to more than 1,000 ft were drilled in the vicinity of The Geysers. Production holes are 12½ in. in diameter.

[6] Condensed from "Geothermal Power" MINERAL INFORMATION SERVICE, State of California, Division of Mines, March 1960.




**FIRST MINE TRUCK** to be powered by gas turbine will be test-run at Inco's open-pit mine in Sudbury district, Ontario.

## 7. The Gas Turbine

A GREAT SURGE in industrial literature on gas turbine applications in both stationary and mobile installations during the past year is indicative of the progress in this field of power generation.

### Turbines in Trucks

For the first time in history, the automotive gas turbine will be subjected to the rugged requirements of ore hauling at International Nickel Co.'s open pit mine in the Sudbury District of Ontario, Canada. Here a 32-ton truck will be powered by a GMT-305 Whirlfire turbine engine manufactured by the Allison Div. of General Motors Corp. The 225-hp engine is a multi-fuel engine with more than double the power of a comparable piston engine per unit of volume, and approximately 70% more power per pound. Inco has long been interested in the potentials of gas turbines for commercial use. Inco research has helped develop the heat-resistant nickel alloys which made possible the use of gas turbines in turboprop and turbojet aircraft.

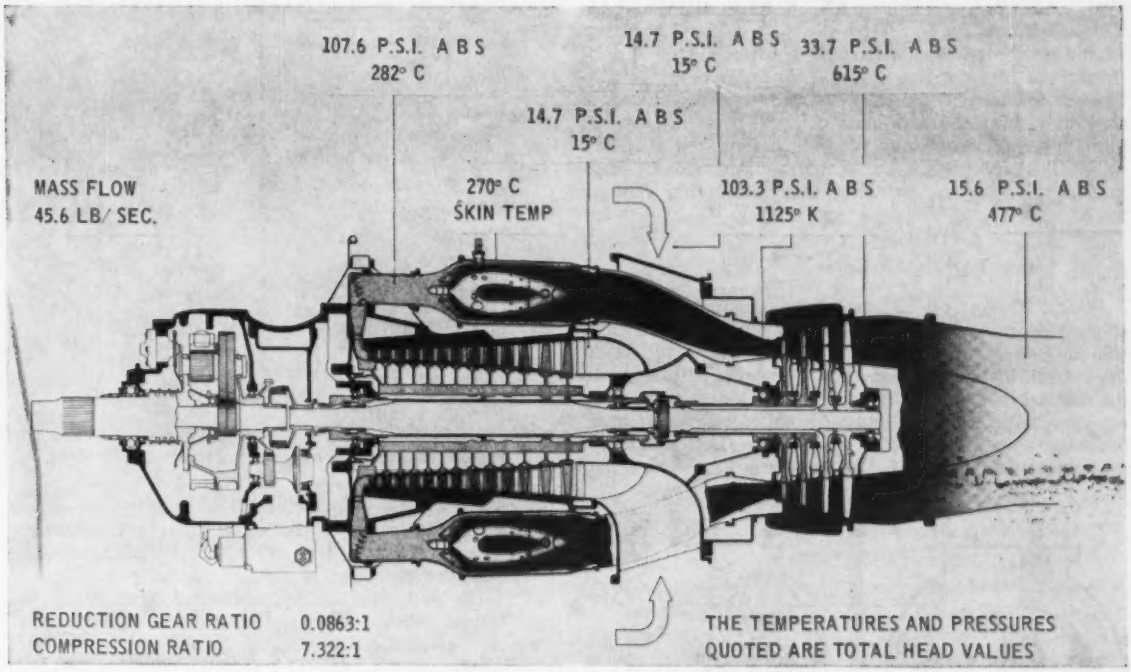
The turbine-powered truck at Sudbury will have to travel nearly two grueling miles over a road winding upward at an 8% grade around the inside of the pit walls. Excessive testing at GM laboratories has proved that a gas turbine engine will deliver more usable horsepower than a reciprocating engine for the same installed horsepower.

The gas turbine is ideally suited for the climate in Sudbury, where the mercury often dips below zero. The GMT-305 engine has been started (after extending cold soaking at —45° F) in about 30 sec. In fact, it can be started at temperatures as low as —65° F.

In addition to the gas turbine purchased by Inco, the Allison Div. of General Motors is manufacturing prototype engines for use in a highway tractor, 28-ft boat, an amphibious lighter, a military track-laying vehicle, and an earth-moving tractor. Other applications include locomotives and stand-by stationary power plants.

### Stand-by Power

A gas-turbine stand-by or power station capable of supplying a town of 10,000 people under emergency condi-




**STATIONARY GAS TURBINE** built by Bristol Siddeley Engines Ltd., Bristol, for the power station shown at right.

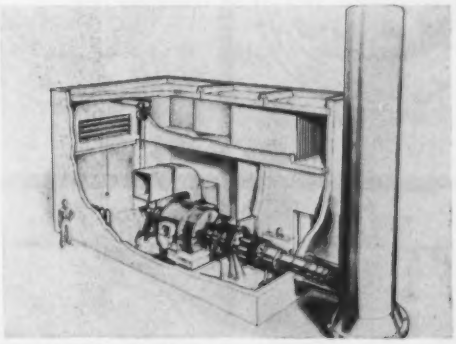
tions has been installed at Princeton, Devon, England. Accompanying illustrations show details of the gas turbine and the complete installation. The 3-megawatt turbogenerator was built by Bristol Siddeley Engines Ltd., Bristol, England. A "free power turbine" is used—one in which the power turbine is not coupled mechanically to the turbine which drives the compressor. This feature is desirable in a remotely controlled set which must operate and start up from a small battery circuit without any external source of power. Air for the turbine is drawn through two banks of sound-absorbing splitters, which are effective in suppressing the high-frequency noise from the compressor. Bristol Siddeley Engines has developed this fully automatic plant based on the use of an aircraft type gas turbine which has already been developed for running on diesel fuel in its marine form as used by the British Admiralty.

## Truck-Mounted Stationary Unit

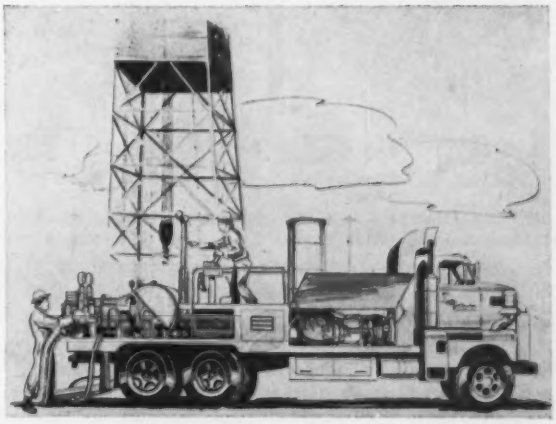
A 900-hp, truck-mounted gas turbine is used on mobile oil-well fracturing units operated by the Halliburton Oil Well Cementing Co. Here a Model 720 General Electric Co. turbine gives operators the high power and speed flexibility required for pump operation. At the same time the unit permits the use of a truck substantially smaller and lighter than is now required for reciprocating engine powered units. Since Model 720 requires no warm-up period before full power is available, the engine need not be started until required. Fuel is also saved because the engine requires no cooling.

## Gas Turbines for Blast Furnaces

The first blast-furnace blowing gas turbine in this country is being installed in the U.S. Steel Corp.'s South



**RAPID-STARTING** automatic gas turbine generating plant is equipped with a 3-megawatt turbogenerator power unit.

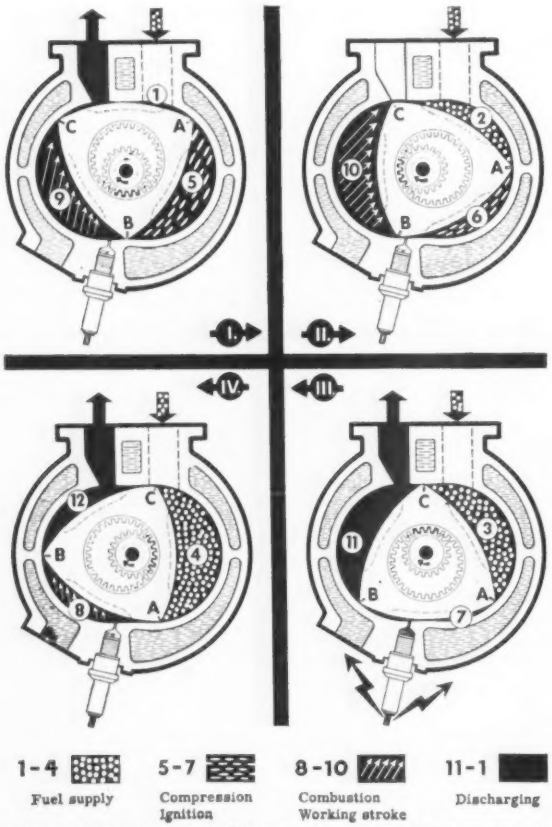


**A 900-HP GAS TURBINE** powers this mobile oil-well fracturing unit. The Model 720 GE engine requires no cooling.

Works in Chicago. This unit will have a capacity of 125,000 cfm at 35 psig. The gas turbine consists of two axial-flow compressors driven by a turbine. One turbine pressurizes blast-furnace fuel gas, and the other pressurizes air for feeding to the gas-turbine combustor and to the blast furnace. Low-heat content blast-furnace gas and air are fed to a single combustor. The unit is started on distillate oil, and once heated, is switched to blast-furnace gas. Source: WESTINGHOUSE ENGINEER, January 1960.

### Turbine Power in Brazil

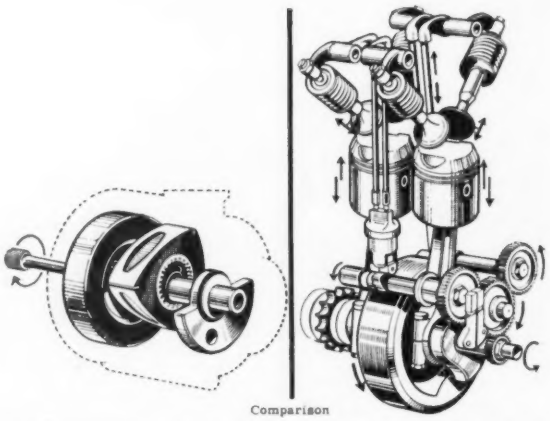
Four 5,000-kw gas-turbine generating units have been shipped from Westinghouse Electric Corp.'s steam division in Lester, Pa., to two state-owned municipalities in the remote mountainous part of Sao Paulo, Brazil. Since the turbines will burn a residual oil with a high percentage of vanadium, calcium and sodium salts, fuel-treating systems were needed to remove these blade-damaging impurities from the oil before combustion.




**REVOLUTIONARY ENGINE** combines the advantages of the turbine and the piston engine. Speed control is remarkable.

## 8. Something New in Engines

EUROPEAN TECHNICAL DIGEST reports a revolutionary type of internal combustion engine in which no reciprocal motion is involved. In other respects, such as ignition and gas mixture delivery, the new design is conventional. The above illustration shows the four phases of operation involved in a single revolution of the rotor-type piston including: introduction of fuel, compression and ignition, combustion working stroke, and gas discharge. Advantages cited for this unit are:




**NEW ENGINE,** at left, offers exceptional savings in size and weight over conventional piston engine shown at right.

1. Drag and friction are minimized because of the constant rotation principle and the mode of power transmission through direct gearing of the rotor to an eccentric drive shaft.

2. The special configuration of the chamber enables a very broad range of revolution control—so very important in the automotive field.

3. Compression ratio and thermal behavior are so favorable that fuel grade is no limiting factor. Fuel economy is remarkable.

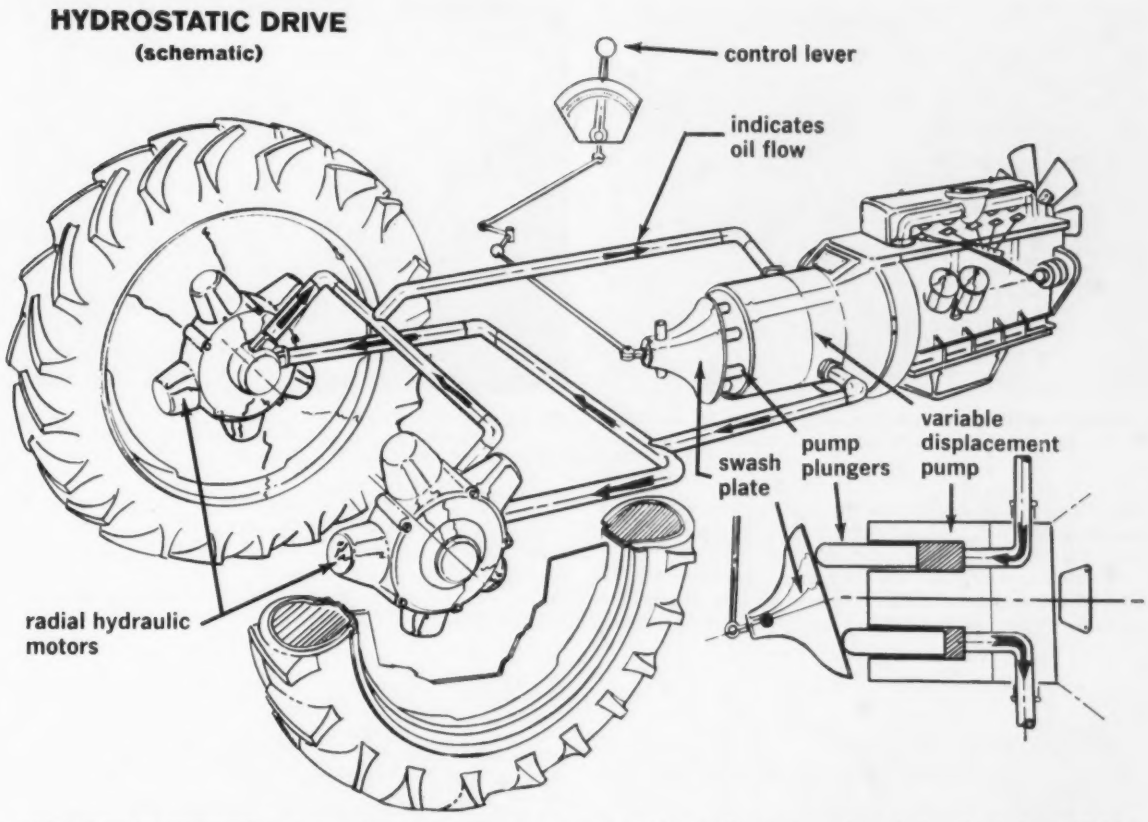
4. Size and weight are considerably less for the new engine, than for a conventional piston engine. (See illustration.)

In a test with a prototype corresponding to a single-cylinder two-stroke 125-cc engine, the prototype delivered up to 20 hp at speeds of 2,000 to 17,000 rpm. Dead weight of the engine was 11 kg. The unit is manufactured by NSU Werke A.G., Neckarsulm, Germany, and has been described in INDUSTRIE-KURIER, December 1959.

## 9. The Hydrostatic Drive

A DRAMATICALLY NEW TRACTOR has been designed by International Harvester Co. called the 340 Utility Tractor. It has no clutch, brake pedals or gear-shift lever. There's no rear axle—only a yoke that serves as a structural member. The big, hollow, main frame casting that houses transmission and differential in conventional tractors is also missing. Also absent are the complex of gears, shafts and splines that have always been needed to link engine with driving wheels. The most notable requirement that is missing is driver effort. Once the engine is started, a single lever on a quadrant near the steering wheel starts forward or reverse motion. It controls speed over an infinitely variable range without clutch and without gear shift. The change from forward to reverse motion requires a simple, corresponding movement of the control lever. In neutral, the lever stops the tractor as positively as any band or shoe brake.

This development is significant of the tractor industry's growing interest in hydrostatic transmission systems. Depending upon oil at high pressure to transmit power by acting on a moving piston, all hydrostatic transmissions de-




**RESEARCH ENGINEERS** at International Harvester Co. are now making studies to determine whether the hydrostatic drive on the tractor shown above will replace gear systems on the tractor of the future. Similar drives are now used on ships.

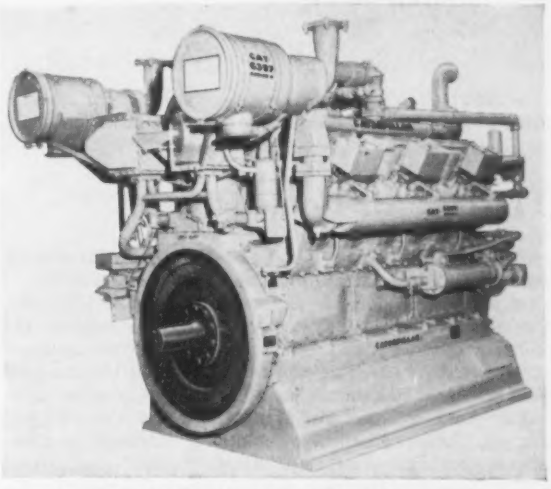
veloped to date (largely in Great Britain) have been experimental. But the idea has been used commercially on ships, winches, ready-mix concrete trucks and in other heavy machinery applications.

The system devised by IH researchers has three major parts: a pair of radial, hydraulic motors—one in each driving wheel—and a variable displacement pump which furnishes pressure energy to the system. The pump is coupled directly to the tractor engine. Piston action in the motors resembles that of a radial aircraft engine, with oil pressure replacing combustion and expansion of gases to move the pistons. The pistons act on an eccentric which serves as a crankshaft, converting hydraulic pressure to torque-twisting force to turn wheels. Will hydrostatic transmissions replace gear systems in the tractor of the future? IH is counting on current research evaluations to turn up a documented answer to that question.

## 10. Low-Cost Gas Engine

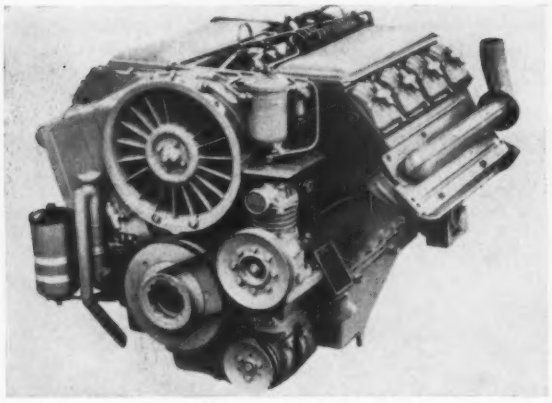
A NEW TURBOCHARGED, aftercooled, spark-fired, natural gas engine has been developed by Caterpillar Tractor Co. which raises horsepower by as much as 90 on the new G 397 unit, to a continuous rating of 560 hp. This engine has a remarkably low fuel consumption rate of 7,000 btu per brake horsepower.

In the past, many gas engines, originally designed to burn gasoline, were later converted to use natural gas. Caterpillar, however, entered the spark-ignition natural-gas engine field from another route. Instead of converting

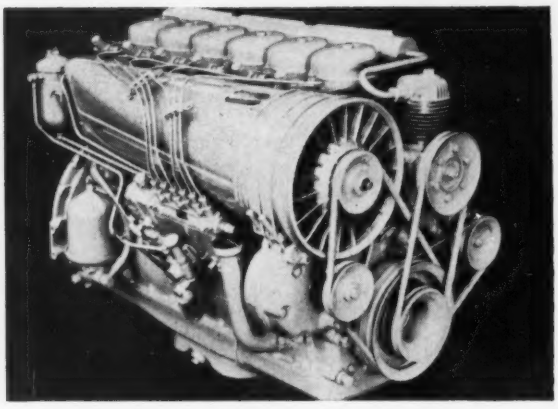


**NEW TURBOCHARGED, AFTERCOOLED** natural gas-engine was designed for low operating cost installations.

a gasoline engine, a stronger, heavy-duty diesel was converted. This could carry continuous loads with a 15:1 compression ratio and a manifold pressure of 55 in. mercury (absolute). Field experience has proven that bearings on the engines are adequate under the above loads. There-



**HORSEPOWER RATINGS RANGE FROM** 25 to 190 at 1,500 rpm for this series of V-type, air-cooled diesel engine.

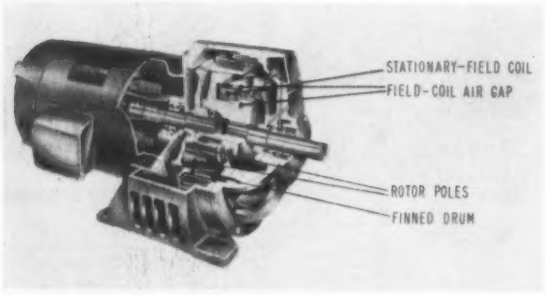


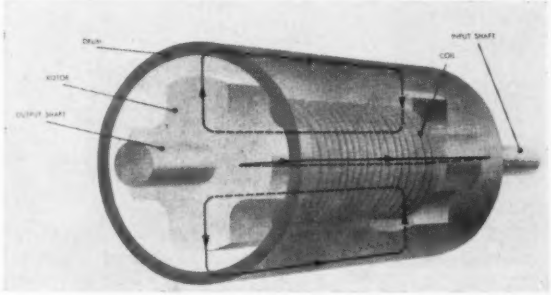
**SIX-CYLINDER, IN-LINE,** air-cooled engine produces 54 hp at 1,800 rpm. Axial-flow blower cools engine.

fore, when operating as natural-gas engines with lower compression ratios, and only about 28 in. of manifold pressure, the bearings are not overloaded.

Heat treatment, special machining and materials in crankshafts and bearings make it possible for the new engines to withstand high bearing loads. Journals are induction-hardened and then superfinished by microhoning.

In the turbocharged, aftercooled model shown here, the natural-gas engine develops 560 hp, or 375 kw, on a continuous day in and day out basis. It is also available in the G 342 size which can produce up to 380 hp, or 250 kw, continuously.



**MAGNETIC LINKAGE** between the rotor and the drum is achieved in the same manner as in the widely-used induction motor. Cutaway unit shows a typical stationary-field electromagnetic drive which transmits power from motor at left.

## 11. The Air-Cooled Diesel

THE AIR-COOLED DIESEL ENGINE is free of bulky radiator pump and hose problems and especially resistant to vibration. It functions normally in temperatures up to 140° and, therefore, is well suited to desert or arid regions. No warm-up period is required even in very cold temperatures, as low as 40°. Full power can be applied in less than 30 sec after a full start. (See photos top of page.)

For these reasons, the Marine and Industrial Engine Div. of Chrysler Corp. has decided to distribute the German-built Deutz Air-Cooled diesel engine.

A unique fuel-injection system makes the engine relatively insensitive to different types of fuel. The exceptionally clean exhaust makes the unit particularly attractive for mining operations.

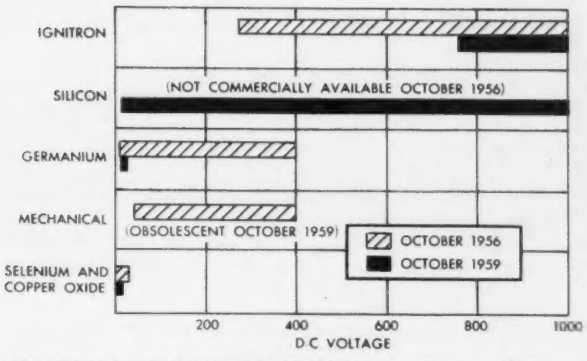
Sales of the air-cooled diesel engine in the U.S. have been slow previously because of lack of distributors. The new engines will eventually be available at 45 engine centers in the U.S.

Several pilot models are now in operation. The Wagner Mining Scoop Co., Portland, Ore., is using one for mining operations. A spudder rig, powered by a Deutz diesel, is being operated by Holt Bros. Drilling Co. on drilling projects in Texas.

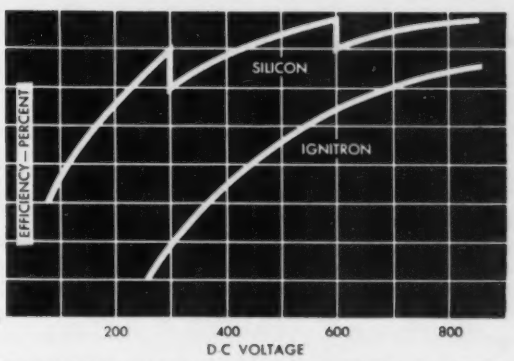
The engines are cooled by a blower which forces air between and around the fins on the cylinder block and heads. In closed areas, provision must be made to carry the heated air away. Both radial and axial flow blowers are used on different models. The addition of the Deutz line permits Chrysler to offer an expanded line of engines from 13 to 290 hp.

## 12. The Electromagnetic Drive

THE ELECTROMAGNETIC DRIVE is an important new development in the field of power transmission. Its operating principle is the same as that of the widely used induction motor. An electromagnetic coupling provides the same functions as the familiar clutch—an adjustable output speed is obtained from constant input speed by controlling the amount of slip between the two rotating members. (See illustration above.) However, unlike clutches, the elec-




**PRACTICAL VOLTAGE SPECTRUM** for various rectifying devices shows progress made in this field in recent years.




**COMPARATIVE OVER-ALL EFFICIENCIES** of 10,000-amp silicon rectifiers and of the ignition-type rectifier.

### How Three Important Rectifiers Compare for Industrial Service

| | Selenium | Silicon | Mercury Arc |
|---|---|---|---|
| Economical unit ratings for 125v. d.c., constant voltage | Up to approx. 50 kw. | 50 to 300 kw. | Not economical |
| Economical unit ratings for 250v. d.c., constant voltage | Up to approx. 30 kw. | 30 to 1,500 kw. | 500 to 1,500 kw. |
| Economical unit ratings for 250–575v. variable voltage, nonreversing packaged drives | Not economical | 30 kw. up | Not very economical |
| Economical unit ratings for 600–700v. variable voltage, heavy nonreversing drives | Not economical | Not economical | Very economical |
| Conversion efficiency | Medium, deteriorates with age | Very good | Medium to good |
| Power factor | 90% lagging | 90–93% lagging | 90–93% lagging |
| Life of rectifier cells and tubes | 6–8 yr. | Expect unlimited life, so far less than 1% cell failures per year | 12–15 yr between tube overhauls |
| Voltage control under load | Expensive | Expensive | Inexpensive for approx. 10% range and for starting duty |
| Cost of rectifier unit | Low | Medium | Medium to high |

tromagnetic coupling has no mechanical contact between the members to cause wear and require adjustment or replacement. Torque is transmitted by an electromagnetic reaction between the two rotating members. Slip produced by this reaction can be continuously controlled much more precisely and over a wider range than is possible with the mechanical clutch. Basic parts of an electromagnetic clutch and a cut-away model are shown above. Source: WESTINGHOUSE ENGINEER, May 1960.

## 13. Progress in Power Rectifiers

VIRTUALLY every large electrical equipment manufacturer has released new information on the comparative performance of the motor-generator, mercury-arc rectifier, and the new silicon and selenium rectifiers developed for industry. The table and charts above show the operating ranges in which the various types of rectifiers are most suitable for common types of applications.

The silicon rectifier has been given considerable emphasis in recent manufacturer's releases. The mercury-arc versus silicon comparison is primarily a matter of degree and application. Both types have characteristics that are desirable in given situations. Properly applied, silicon diodes have unlimited life compared to the slow, gradual aging, of mercury-arc tubes. With mercury-arc, however, voltage control is inherent.

Recently Westinghouse and Aluminum Co. of America developed a compact ac-to-dc silicon converter rated at 10,000 amp at 600 v which can produce up to 4% more aluminum per kwh. The converter delivers 6,000 kwh from only 312 silicon rectifier cells. The over-all efficiency of the new equipment exceeds 97%.

Sources: "The Silicon Rectifier," A. P. Colaiaco, Semi-conductor Section, and C. S. Hague, Power Conversion Engineering, Westinghouse Electric Co. "How to Pick the Right Rectifier," W. E. Gutzwiller, Allis-Chalmers Mfg. Co., CHEMICAL ENGINEERING, October 1959.

# Mineral Processing

THE NEXT 12 PAGES PRESENT 12 flowsheets, of various processes and for various materials. Taken together with flowsheets published in previous issues of E&MJ's Mining Guidebook, they form a portfolio of modern mineral processing practice. References indicate recent issues of E&MJ in which feature articles dealing with the respective plants appeared. By referring to these articles, you can find complete information about these plants and processes.

Flowsheets presented here are as follows:

**Magnesium, Ferrosilicon Reduction Process,** Alabama Metallurgical Corp., Selma, Ala.

**Copper, Electrolytic Refinery,** Kennecott Copper Corp., Baltimore, Md.

**Iron Ore, Wet Upgrading Plant,** Salzgitter A.G., Salzgitter Calbecht, West Germany

**Nickel, Concentrating Plant and Refinery,** Freeport Nickel Co., Moa Bay, Cuba, and Port Nickel, La.

**Alumina, Nepheline Reduction Process,** Pikalevo and Volkhov Works, U.S.S.R.

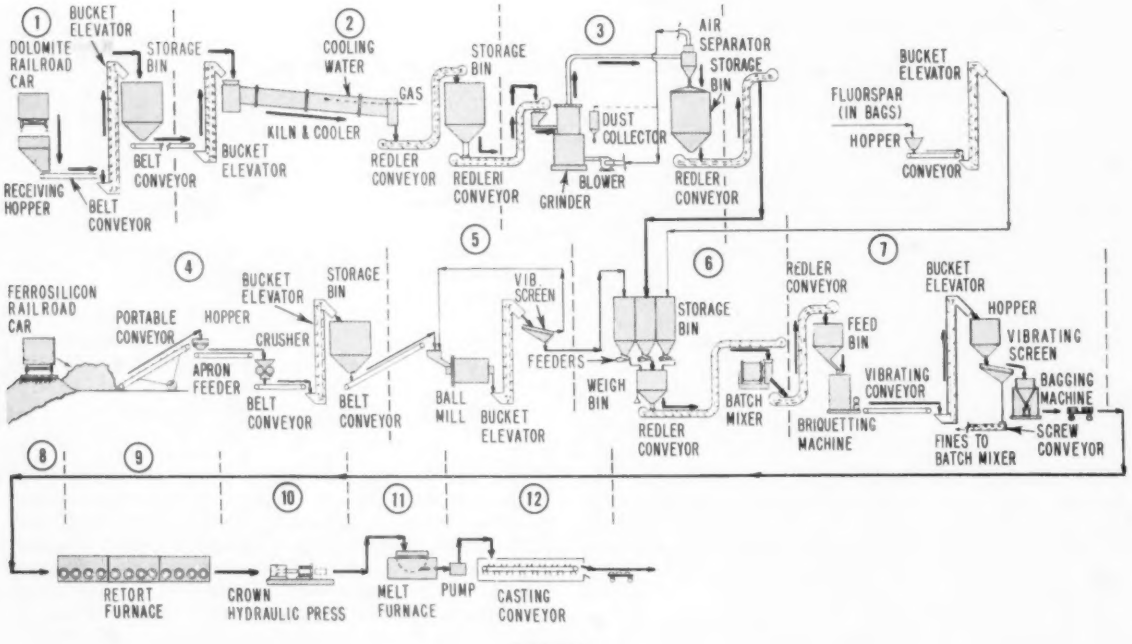
**Copper, Leaching-Precipitation-Flotation Process,** Kennecott Copper Corp., Hayden, Ariz.

**Uranium, Automated Leaching-Precipitation Mill,** Homestake-Sapin Partners, Grants, N.M.

**Manganese, Dithionate Leach Process,** U.S. Bureau of Mines, Boulder City, Nev.

**Silver, Reclamation of Old Cyanide Tailings,** Cia. Real del Monte y Pachuca, Pachuca, Mexico

## Ferrosilicon Process for Production of Magnesium from Dolomite Ore, Alabama Metallurgical Corp., Selma, Ala.

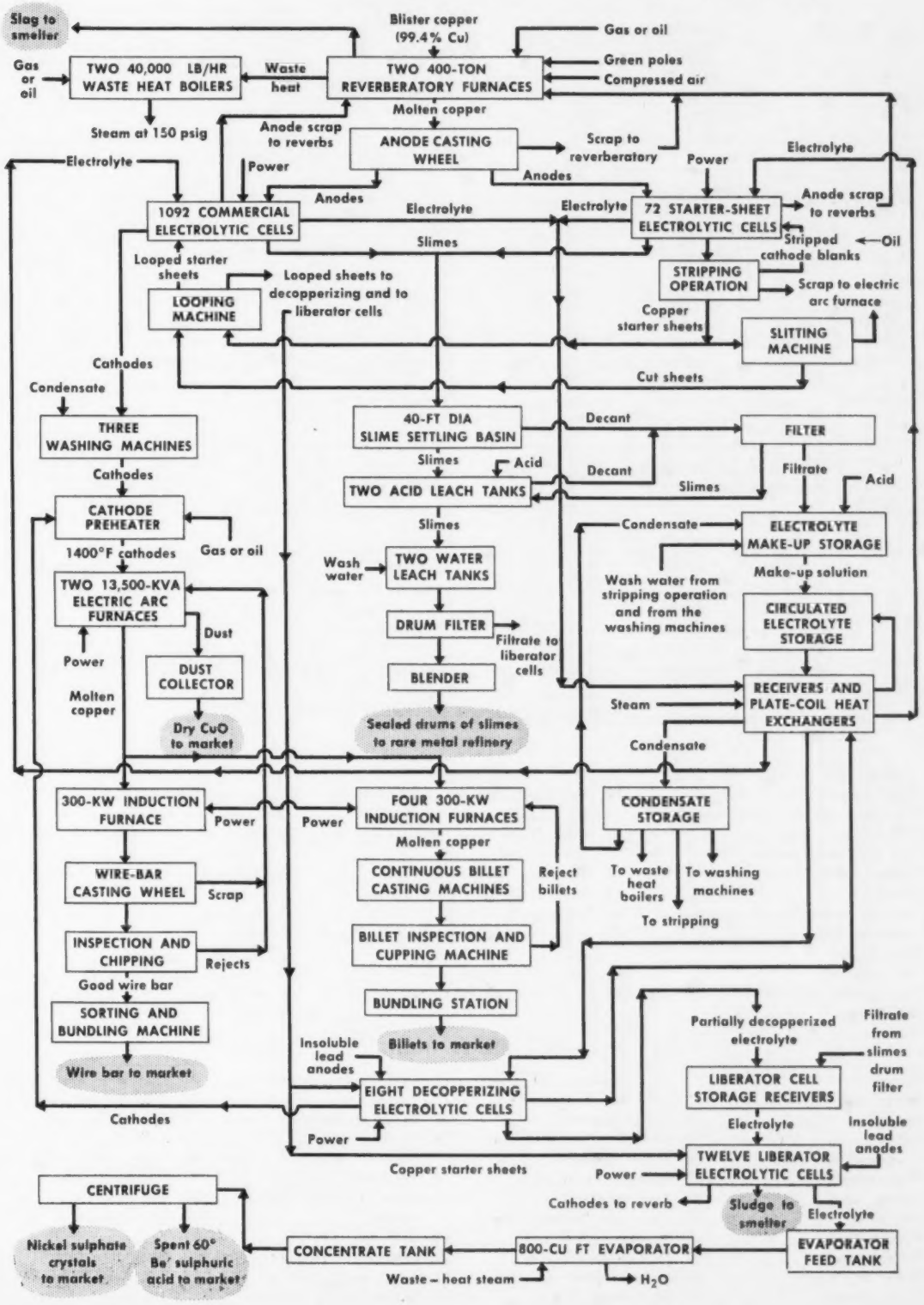



**LEGEND**

1. Dolomite ore comes by rail from quarry, is transferred to storage bin
2. Dolomite, $CaMg[CO_3]_2$, is heated in kiln to release $CO_2$, goes into second storage bin as MgO & CaO
3. Calcined ore is ground to powder, goes to third storage bin
4. Ferrosilicon comes to plant by rail; is unloaded, crushed, put into storage bin
5. It is pulverized in ball mill, screened on vibrating screen
6. Weighed amounts of calcined dolomite, fluorspar & ferrosilicon are mixed in batch mixer
7. Mixture is fed into briquetting machine; machine forms small briquettes; these are bagged
8. Bags are taken to retort furnace, retorts are charged
9. Air is exhausted from gas-fired retorts; briquettes are heated in vacuum. Magnesium separates as vapor, leaving $CaSiO_3$ & Fe as residue. Magnesium vapor condenses on cooled end section of retort, forming cylindrical "crown"
10. Crowns are removed from retort by crown press
11. Crowns are melted in melt furnace
12. Molten high-purity magnesium is pumped from melt furnace to ingot molds, cast into ingots

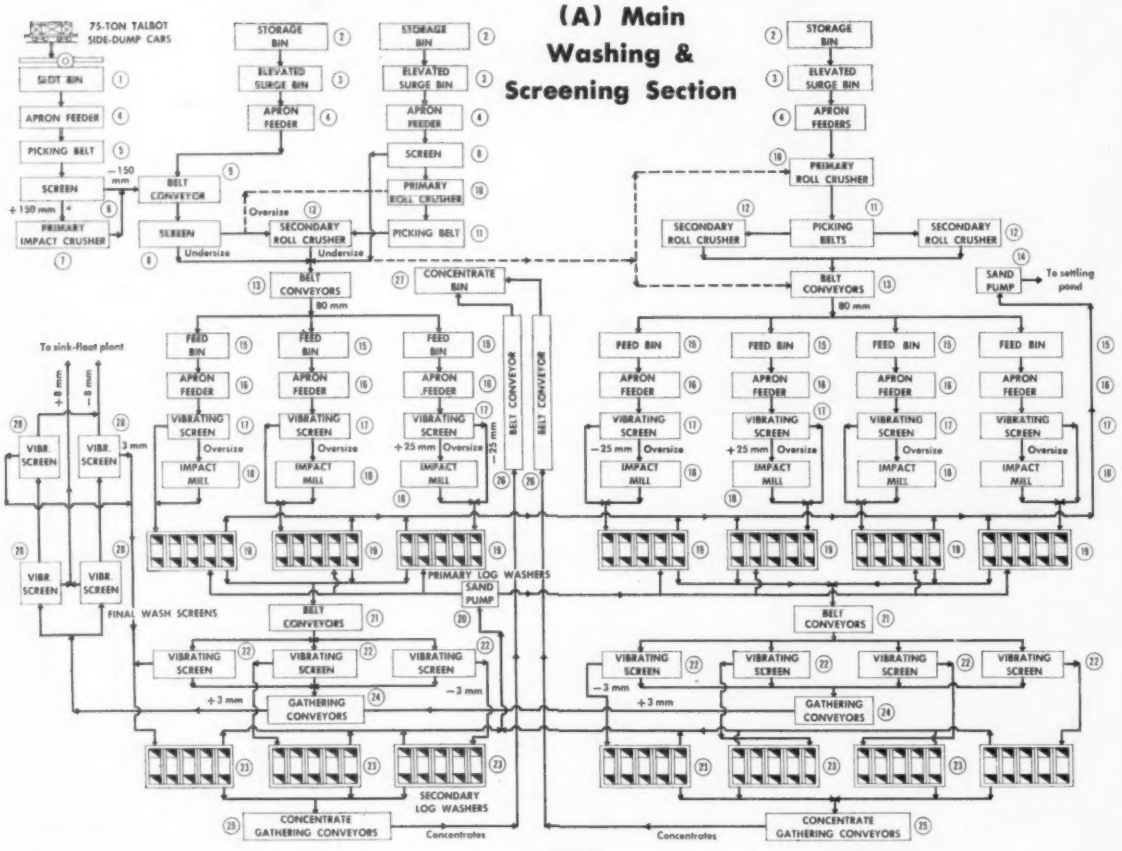
# Copper Refinery Flowsheet, Kennecott Refining Co., Baltimore, Md.

(E&MJ, March 1960)



# Brown Iron Ore Upgrading Plant; Salzgitter AG, Salzgitter Calbecht, West Germany

## (A) Main Washing & Screening Section




### LEGEND

1. 1,000-ton slot bin below rail level
2. Three concrete storage bins (combined capacity, 50,000 tons)
3. Three 75-ton surge bins
4. Four steel apron feeders
5. Rubber picking belt
6. Screen
7. Hazemag primary impact crusher (capacity, 500 tph)
8. Two screens
9. Belt conveyor
10. Two primary roll crushers (Humboldt and Krupp)
11. Three picking belts
12. Two Humboldt and one Krupp secondary crushers
13. Three incline belt conveyors 650 and 800 mm wide
14. Centrifugal sand pump
15. Seven 15-ton feed bins
16. Seven apron feeders
17. Seven vibrating screens, 1x2 m, 25-mm openings
18. Seven SAP4 impact mills
19. Seven sets of Salzgitter primary log washers
20. Centrifugal sand pump
21. Inclined belt conveyors
22. Seven vibrating screens
23. Seven sets of Salzgitter secondary log washers
24. Gathering conveyors for minus 3 mm material
25. Gathering conveyors for final concentrates
26. Twin belt conveyors
27. Concentrate storage bin (capacity, 8,000 tons)
28. Four final washing screens

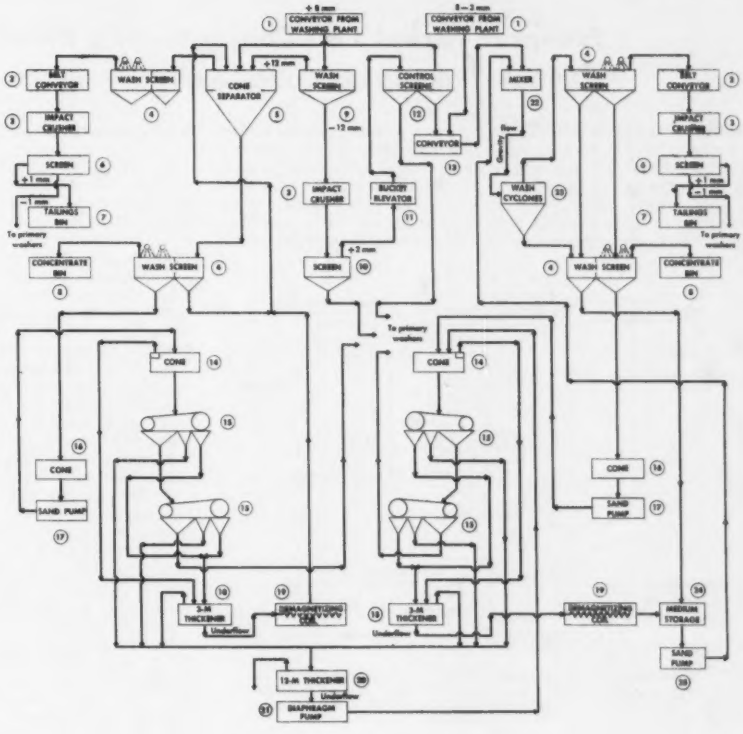
## (C) Slime Plant

1. By-pass spout
2. Screen spout
3. Pump sump
4. Sump
5. Centrifugal sand pump
6. Pump sumps
7. Settling cone
8. Disk filter
9. Vacuum tank
10. Filtrate pump
11. Water ring pump
12. Rotary blower
13. Wet cyclones (30 primary and 5 secondary)
14. Incline conveyor
15. Babcock rotary feed bin
16. Incline conveyor
17. Büttner-Schwebe dryer
18. Dust separator
19. Two von Tongeren dry cyclones
20. Two air locks
21. Screw conveyor
22. Dust storage bins
23. Two vibrating screens
24. Hammer mill
25. Redler conveyors
26. Bucket elevators
27. Salzgitter magnetic separators
28. Fuller pneumatic pump system
29. Cloth tube filter
30. Concentrate storage bins
31. Two mixing screws
32. Incline loading conveyor
33. Flue with water sprays
34. Drop sampler
35. Exhaust fan
36. Agitator
37. Pump sump
38. Centrifugal sand pump
39. Dry cyclone
40. Dust separator
41. Fan
42. Cloth tube filter
43. Two Redler conveyors and bucket elevator

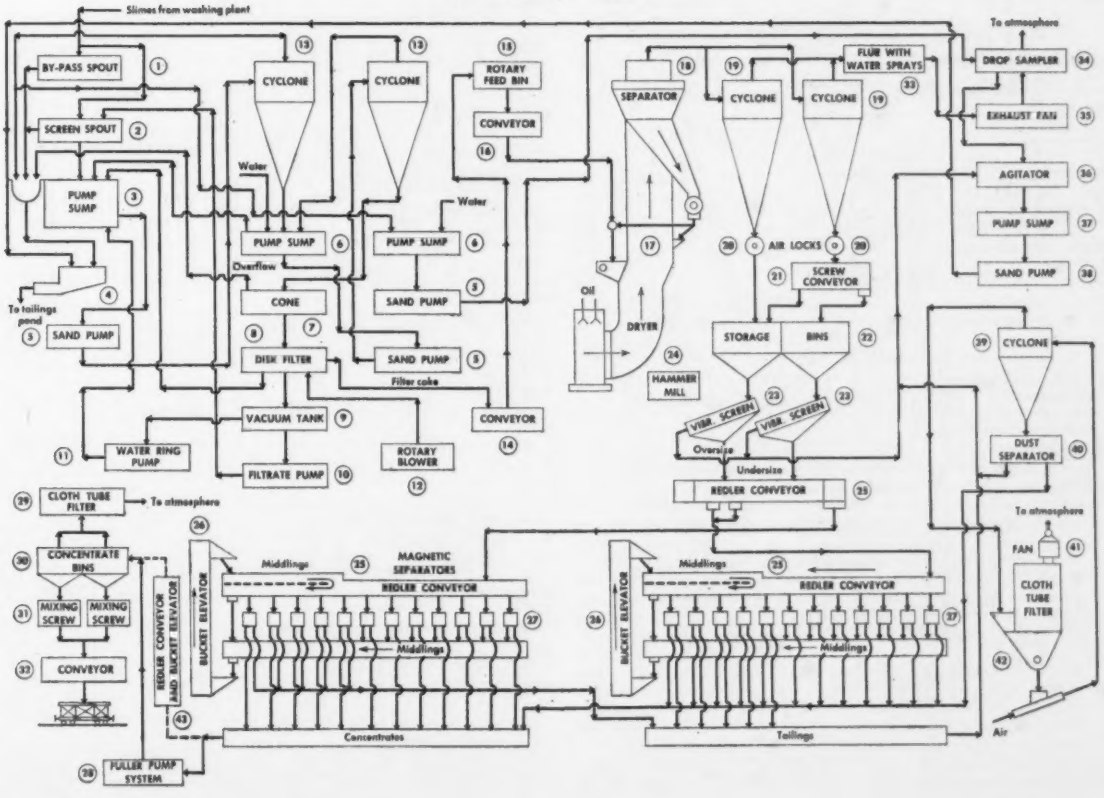
## (B) Sink-Float Plant

**LEGEND**

1. Two belt conveyors from washing plant
2. Belt conveyor
3. Four impact mills
4. Three float wash screens and three sink wash screens
5. 3-m cone separator vessel
6. Screen
7. Tailings bin
8. Concentrate bin
9. Primary wash screen
10. Screen
11. Bucket elevator
12. Control screens
13. Conveyor
14. Two settling cones
15. Ten magnetic separators
16. Two settling cones
17. Two centrifugal sand pumps
18. Two 3-m thickeners
19. Two demagnetizing coils
20. 12-m thickener
21. Diaphragm pump
22. Mixer
23. Two cyclones in parallel
24. Heavy medium storage
25. Centrifugal sand pump

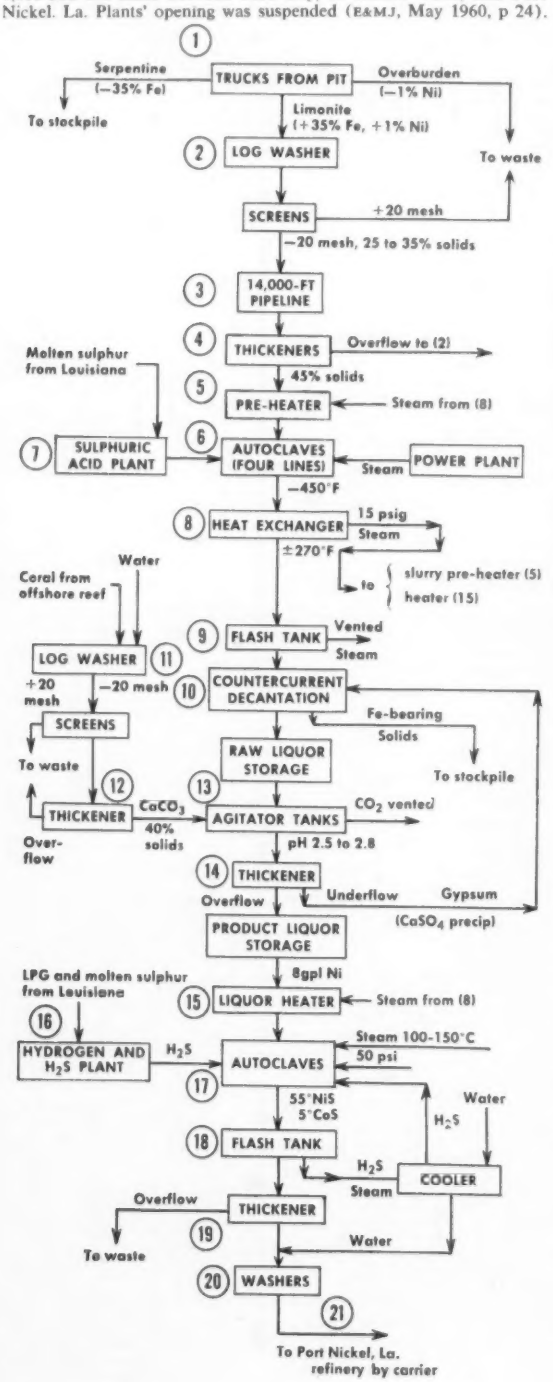


## (C) Slime Plant



# Freeport Nickel Co.—Concentrating Plant at Moa Bay, Oriente Province, Cuba—Refinery at Port Nickel, La.

THESE TWO FLOWSHEETS describe the complex process whereby Freeport Nickel Co. was to reduce low-grade lateritic iron ore containing 1.36% Ni and 0.13% Co to nickel and cobalt powder and briquettes (E&MJ, Dec. 1959). The link between the two flowsheets is a slurry-carrying modified cargo ship which would ply the 1,100-odd sea miles between Moa Bay, in eastern Cuba, and Port Nickel. La. Plants' opening was suspended (E&MJ, May 1960, p 24).




## LEGEND FOR CONCENTRATING PLANT

**1.** Ore is mined by dragline from the iron laterite deposit. Overburden, low in cobalt and nickel, goes to waste. Limonite ore is decomposed by tropical weathering, provides working ore. Low grade, partially decomposed serpentine (minus 35% Fe) is stockpiled for possible future treatment. Eighteen 30-ton Oshkosh diesels haul the ore. Truck exhaust heats the body to reduce ore sticking.

**2.** Agglomerated ore is broken up in four McLanahan & Stone log washers and made into 35% slurry. Plus 20 mesh contains little nickel, goes to waste. About 90% of original ore is minus 325 mesh, screening to minus 20 eliminates about 5% of feed, including some hematite lumps, etc. Screens are by Simplicity Mfg. Co.

**3.** 24-in. concrete pipeline, buried on a 1½% grade, takes the ore 14,000 ft to the leaching plant at 8 fps.

**4.** Two 325-ft dia Dorr-Oliver raw ore thickeners take slurry down to 45 to 48% solids. Feed rate is 5,500 tpd of ore on a dry basis, which makes about 11,500 tpd of 45% slurry.

**5.** Slurry is pre-heated to 180°F by recovered low pressure (15 psig) steam from the slurry coolers.

**6.** Four parallel lines of four autoclaves in series leach the slurry. In each line, the head tower brings the solution to 450°F with contact steam. Best results have been obtained when sulphuric acid is introduced after reaction temperature has been obtained. The slurry then flows by gravity through the 55-ft high, 9-ft dia reactor vessels. In general, contact time is one to two hours. Autoclaves are agitated by high pressure steam, injected below the bottoms of concentric mounted draft tubes (steam is drawn off to the preheater —No. 5). 98% $H_2SO_4$ is pumped into the first vessel of each line. Draft tubes, valves and couplings and interstage piping are all of titanium. The steel vessels themselves are lined with a bonded lead lining beneath a course of acid brick and a second course of carbon brick. In the operation, iron and other metals do not go into solution, but 95% of the cobalt and nickel is extracted.

**7.** $H_2SO_4$ is produced at the plant site from molten sulphur, which is shipped from Louisiana in the same vessel which hauls Nis-CoS concentrate to the U.S. The sulphuric acid plant has a capacity of 1,300 tpd of 98% acid. 50% of high-pressure process steam is generated through the waste-heat recovery system.

**8.** Two heat exchangers per line of autoclaves receive the slurry and recover 15 psig steam by indirect transfer. Exchangers are of tubular titanium, 3,720 ft of it, and provide a total transfer area of 1,450 sq ft.

**9.** Reduction to atmospheric pressure takes place in the flash tanks through ceramic or silicon carbide chokes. Some flow is controlled by splitting the discharge stream, but the greater part (90%) flows through an open choke. Rate control is maintained on the by-pass stream where the control valve is tied with the liquid level in the fourth reactor.

**10.** Six-stage countercurrent decantation separates the main iron bearing solids from the solution and its nickel-cobalt-aluminum-magnesium-chromium content, the latter three minerals in minor content and iron in negligible amounts. Iron-bearing solids are stockpiled for possible future use. Six 225-ft Eimco traction-type washers are used.

**11.** Calcium carbonate, required to adjust the pH before precipitation, is obtained from an offshore coral reef by dredges, and recovered as a mud running 95% or more $CaCO_3$. It is washed with fresh water and screened to remove shells, trash and plus 20 material, as well as the chlorides.

**12.** Cleaned $CaCO_3$ is thickened to 40% solids in a 160 ft Eimco unit.

**13.** Agitated tanks receive the raw liquor and coral and the pH is rapidly adjusted to 2.5 to 2.8. The four tanks (in series) are wood, and use Philadelphia mixers.

**14.** Clarified solution from the agitators, containing about 6 gpl nickel and lesser amounts of cobalt, copper, lead and zinc is the product of two 160 ft Dorr-Oliver thickeners, which remove the gypsum and return it to the decantation system.

**15.** Specially designed direct contact heaters, bricklined and combining two Hastelloy-C perforated trays, preheat the solution to 245°F.

**16.** To supply the precipitation process, hydrogen produced at the rate of 1.5-million cubic ft per day from liquid petroleum gas (LPG) reformed with steam, is combined with sulphur to make hydrogen sulphide. The $H_2S$ generator at Moa Bay is fed propane-butane and molten sulphur from Louisiana and can produce up to 60 tpd of $H_2S$. Both the hydrogen and hydrogen sulphide plants are of Girdler design.

**17.** Virtually all the nickel and cobalt is precipitated out in three-compartment brick-lined autoclaves, agitators from Turbo-Mixer.

Pure $H_2S$ is added from the plant. Satisfactory results require a temperature between 220°F and 260°F and a pressure of 50 psi. The $H_2S$ is introduced below the surface and the mixture agitated. NiS is recirculated as "seed" on which the sulphides precipitate, preventing buildup on the walls and stirrers of the autoclave. A satisfactory pH has been found to range between 2.0 and 2.5. Reaction time is a function of temperature, pressure and efficiency of agitation.

**18.** The slurry is flashed through chokes to atmospheric temperature similar to (9), $H_2S$ and steam circulated to a cooler for reclamation.

**19.** Precipitated sulphides are separated in two 60-ft Eimco thickeners with Hastelloy-C mechanisms and barren solution is overflowed to waste.

**20.** Countercurrent decantation takes place in the final washer, a 30-ft dia Dorr-Oliver. Final product is a 65% solid in slurry, containing 55% Ni, 5% Co, and lesser sulphides of copper, zinc and iron. Freeport estimates that 93% of the nickel originally in the ore is to be found in the sulphides.

**21.** The ship which takes the slurry to Port Nickel, La., is a modified cargo vessel fitted with containers and compartments to bring molten sulphur and LPG from the mainland and carry a return cargo of sulphides to the refinery. Sulphide storage is provided at the harbor in Moa Bay. Slurry is transferred from plant in cement-mixer trucks.

## LEGEND FOR REFINERY

**1.** The settled slurry in the ship's tank is resuspended at Port Nickel and a 65% solids slurry is pumped via a 1,800-ft cement-lined 8-in. pipeline to a tank farm of sixteen 20-ft dia tanks. The slurry is permitted to settle in the storage tanks and is resuspended as needed by a unique agitator specially manufactured by the Philadelphia Gear Works which can be raised and lowered in each tank and moved from tank to tank as needed.

**2.** The typical components of the slurry (dry weight) are as follows:

| | | | |
|---|---|---|---|
| Ni | 53.76% | Zn | 1.25% |
| Co | 5.28% | Cu | 0.52% |
| Fe | 0.59% | Cr | 0.04% |
| Al | 0.04% | S | 35.21% |

**3.** Oxidation of the sulphides to soluble sulphates takes place in three spherical homogeneously lead-lined steel autoclaves, each 13 ft in dia and internally lined with acid brick. On each autoclave is a Philadelphia Gear Works agitator having a 6-in. titanium shaft and titanium impellers. Baffles and internal piping in the autoclaves are of titanium. The sulphide slurry, additional water, sulphuric acid and air are continuously charged to the autoclaves where the sulphides oxidize in an exothermic reaction to sulphates. The slurry, after leaching, discharges through titanium letdown valves to an acid brick-lined flash tank and the overflow from the flash tank discharges to a small Dorr thickener where excess sulphide is collected and returned to the autoclave feed stream. Leached solution is controlled at 50 gpl Ni and 5 gpl Co. The spent air discharges from the autoclaves via titanium letdown valves.

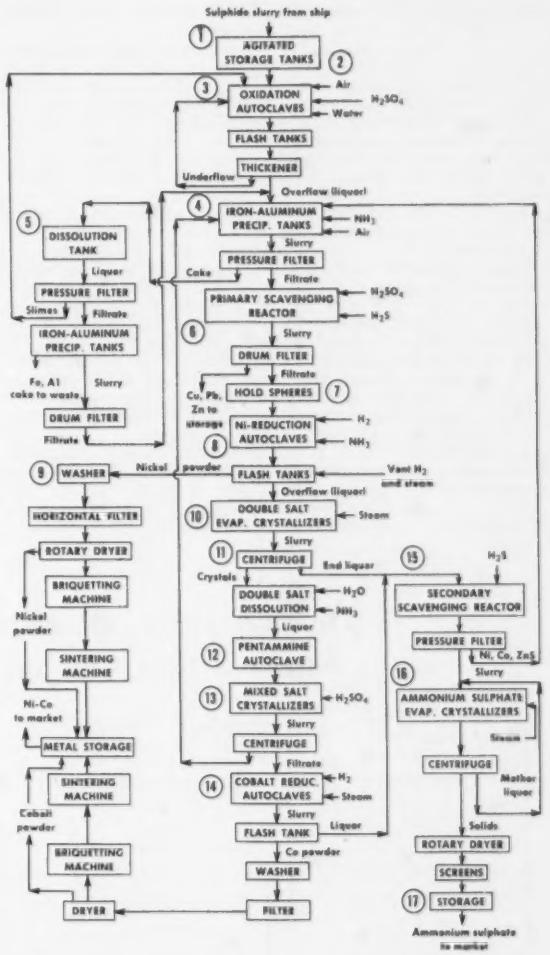
**4.** Precipitation of the minor amounts of iron, aluminum and chromium contained in the solution takes place by adjustment of the solution's pH to 5.5 with ammonia. Air is introduced into the precipitation reactors to insure that all iron present is in the ferric state. The precipitate is filtered in a pressure filter supplied by the U.S. Filter Co.

**5.** The precipitate of iron, aluminum and chromium, mostly in the form of hydroxides, contains a considerable amount of nickel and also a small amount of fine sulphide slimes which overflowed the thickener. The precipitate is reprocessed by dissolution with sulphuric acid followed by pressure filtration of the sulphide slimes which return to the oxidation autoclaves. The clarified filtrate is reneutralized with ammonia to a pH of 5.0. The resultant slurry is then filtered on a string filter supplied by Komline-Sanderson Co. The precipitate is discarded as waste and the filtrate joins the overflow from the thickener.

**6.** The main filtrate stream from the iron-aluminum precipitation operation is treated with sulphuric acid and hydrogen sulphide in the primary scavenging pipe coil reactor to remove copper, lead and a portion of the zinc as a sulphide precipitate. This precipitate is separated from the filtrate on two large Komline-Sanderson precoat drum filters. The sulphide residue is presently regarded as a waste, but is stored for its potential value.

**7.** The liquor from the primary scavenging operation containing nickel and cobalt sulphates and a small amount of ammonium sulphate is heated to 375° and delivered to two elevated spherical hold tanks each 22¼-ft dia. These tanks, of 316 ELC clad steel, supply heated feed liquor to the six nickel reduction autoclaves.

**8.** As required, liquor is discharged from the spherical hold tanks to the nickel reduction autoclaves where nickel is selectively recovered as a powder by reduction with hydrogen. Selective recovery of nickel is achieved by maintaining a pH of approximately 2.0 in




the autoclave by controlled addition of ammonia. The six nickel reduction autoclaves are each 9-ft dia by 29 ft over-all length. They are 10% 316 ELC clad steel. Each autoclave is equipped with three 125-hp agitators supplied by Mixing Equipment Co. Reduction of nickel from solution is a batch operation and after each reduction—or densification as it is called by the operators—the nickel powder is permitted to settle in the autoclaves and the hydrogen and spent liquor are discharged to a flash tank. Upon completion of a series of densifications both the nickel powder and the spent liquor are discharged together to a flash tank.

**9.** Washing of the nickel powder takes place in two spiral classifiers in series which discharge to a horizontal rotary filter supplied by Filtration Engineers Inc. The dewatered nickel powder discharges from the filter to a 5-ft dia co-current direct fired rotary dryer supplied by Standard Steel Corp. Some of the dried nickel powder is packaged in drums but the major amount is briquetted in two Komarek-Greaves briquetting presses. The briquettes are sintered in a roller-hearth belt-type furnace supplied by the Drever Co. Sintering is done at approximately 1750°F under a reducing atmosphere. Immediately after the sintering operation the briquettes are drummed for shipment.

**10.** The end liquor from the nickel reduction operation is evaporated and crystallized to recover the cobalt, the residual nickel and a small amount of zinc as a double sulphate salt with ammonium sulphate. Evaporation and crystallization take place in a quadruple effect evaporator-crystallizer supplied by the Chicago Bridge & Iron Co.

**11.** The crystallized slurry from the evaporator-crystallizer is centrifuged in a Bird Machine Co. continuous centrifuge. The mother liquor is delivered to the secondary scavenging section of the refinery. The double salt crystals are redissolved with water and anhydrous ammonia for further processing for cobalt recovery.

**12.** The redissolved double salt solution is oxidized with air under several hundred pounds pressure in the pentammine autoclave where

the cobaltous ion is converted to a stable cobaltic amine complex.

**13.** The product liquor from the pentammine autoclave is adjusted with sulphuric acid and is then cooled in a two stage crystallizer, supplied by the Chicago Bridge & Iron Co., in which the nickel and zinc are crystallized as double salts with ammonium sulphate but in which the cobalt, bound in the stable amine ion, does not crystallize. The double salt containing nickel and zinc—called mixed salt at the refinery—is centrifuged from the cobalt containing liquor in a Bird centrifuge. The nickel-zinc crystals are returned to the front end of the process joining the overflow stream from the thickener.

**14.** The cobalt rich liquor from the mixed salt crystallization operation containing substantially no nickel is charged in batches to two 9-ft dia by 10½ ft over-all length 10% 316 ELC clad steel reduction autoclaves. Each autoclave is agitated by a 125-hp Mixing Equipment Co. agitator. The liquor is heated in the autoclave with steam and the cobalt is reduced to a powder by hydrogen under pressure. The cobalt precipitates in much the same manner as the nickel and is filtered, washed, treated, packaged and briquetted. The only significant difference in the preparation of the cobalt powder is in the drying where a continuous belt dryer, supplied by the Drever Co., operating at 1000°F under a hydrogen atmosphere, is used. By this drying procedure, an extremely high grade cobalt powder containing a minimum of oxide is obtained.

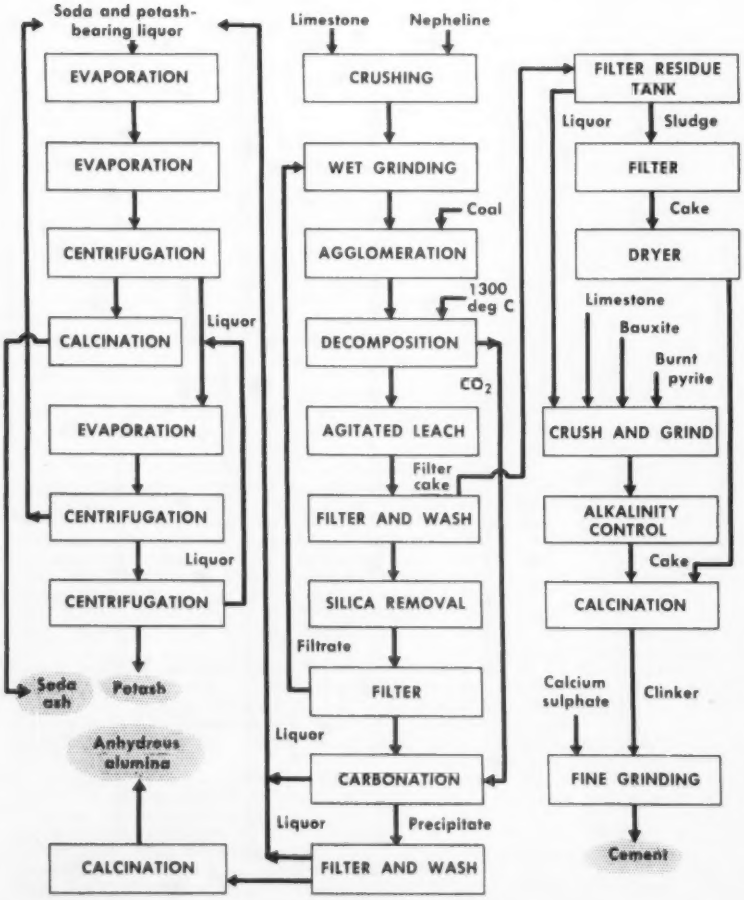
**15.** End liquors from the cobalt reduction operation and from the double salt crystallizer operation are combined in the secondary scavenging operations and are stripped of residual metals with hydrogen sulphide in a pipeline reactor similar to that used in the primary scavenging operation. The metal sulphides are filtered in a pressure filter supplied by the U.S. Filter Co. and are returned to the oxidation autoclaves for reprocessing.

**16.** The filtrate from the secondary scavenging operation is delivered to a double effect evaporator-crystallizer supplied by the Chicago Bridge & Iron Co., where ammonium sulphate crystals are recovered for marketing as a by-product. The ammonium sulphate crystals are centrifuged from the mother liquor in two Sharples C-27 Super-D-Hydrators and are dried in a 6-ft dia Standard Steel Corp. co-current direct fired dryer.

**17.** The ammonium sulphate—produced at the rate of approximately 270 tpd—is stored in bulk in a laminated timber arched storage building 122 x 300-ft supplied by Timber Structures Inc. Wood construction was chosen for the ammonium sulphate storage building because of the difficult corrosion problems encountered on the Gulf Coast in storing ammonium sulphate. The plant is equipped to ship ammonium sulphate in bags or in bulk.

**18.** As auxiliaries to the processing operations, the Port Nickel refinery is equipped with a number of interesting utility installations. High pressure air is obtained from four 2,000-hp Ingersoll-Rand 412 KVS gas engine driven compressors which together are capable of delivering 16,000 cfm of air at 800 psig. Hydrogen, required in the nickel and cobalt reduction operations, is generated in a Chemical Construction Corp. hydrogen plant utilizing pressure reforming of natural gas at a rate of 2-million cfd. And hydrogen sulphide, used in the primary and secondary scavenging operations, is produced at the rate of 2.5 tpd from molten sulphur and hydrogen in a plant designed by the Girdler Corp. Steam is generated in three gas-fired package boilers rated at 60,000 lb/hr each at 315 psig, supplied by the Foster Wheeler Corp.

## Alumina From Nepheline (Idealized Flowsheet); Pikalevo and Volkhov Alumina Works, USSR



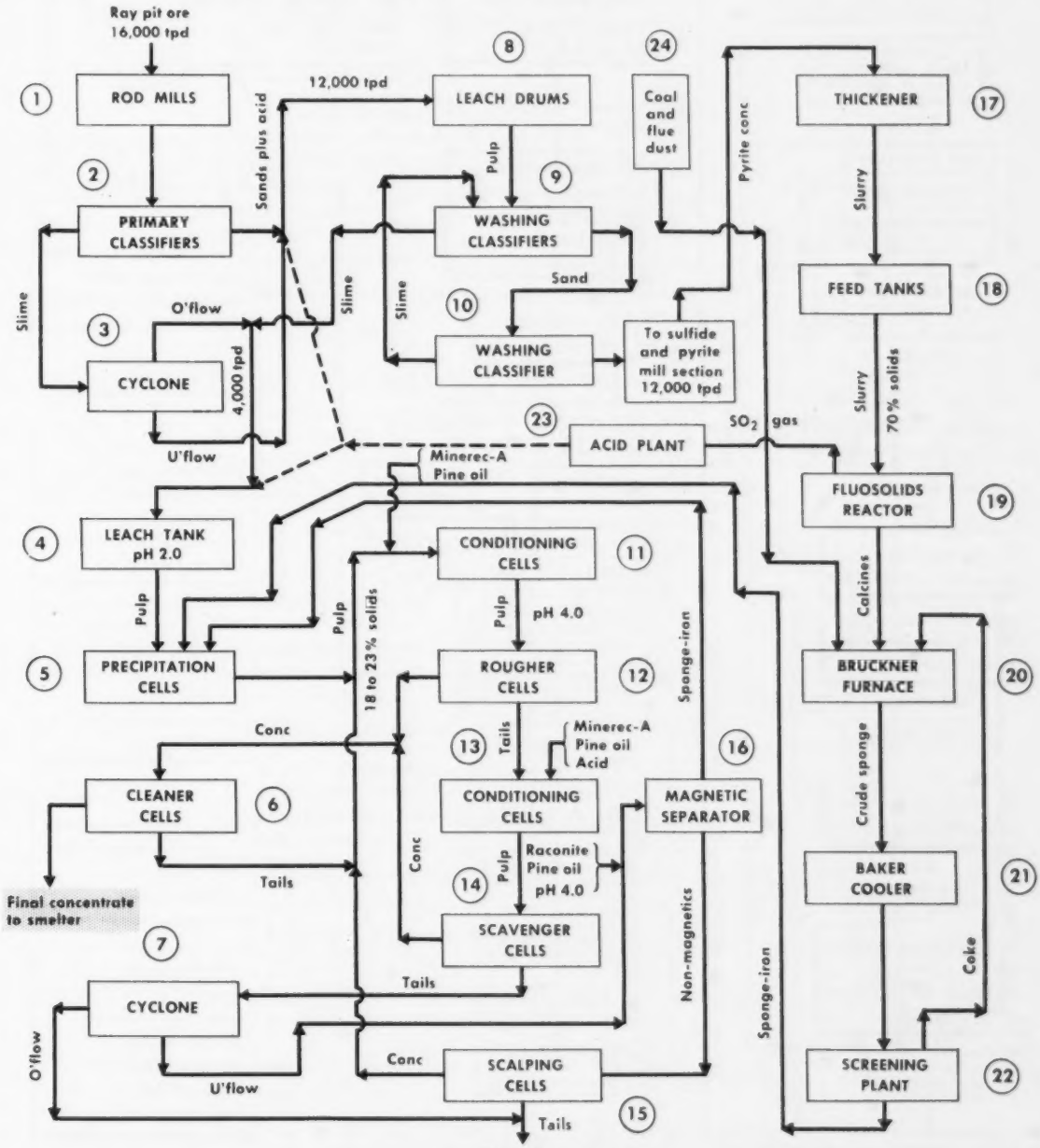

THE SOVIET UNION'S expanding aluminum industry uses the technology represented in this flowsheet to produce alumina, as well as the important by-products soda ash, potash and cement, from Russia's deposits of nepheline, which her government claims are the "world's largest." (E&MJ, May 1959)

Nepheline extracted from the deposits in Russia's Kola Peninsula is treated in the flowsheet at left, which starts with ore assaying about 30% alumina, 20% potash and sodium, 43% silica and 7% others. A slurry is made with limestone, and ignited with fine coal at 650 to 1000°C in a kiln. Here the limestone decomposes, giving off $CO_2$ and forming lime. This reacts at 1300°C with the nepheline, to form a clinker composed of dicalcium silicates and water-soluble aluminates of sodium and potassium. Silicates go to cement production. The alumina-bearing solution is autoclaved in a $CO_2$ atmosphere (the $CO_2$ produced by the calcination of the limestone), producing alumina as the hydroxide. A major reason for the economy of the process is said to be the production of three valuable by-products in addition to alumina—soda ash, potash and cement.

Kennecott's L-P-F Process

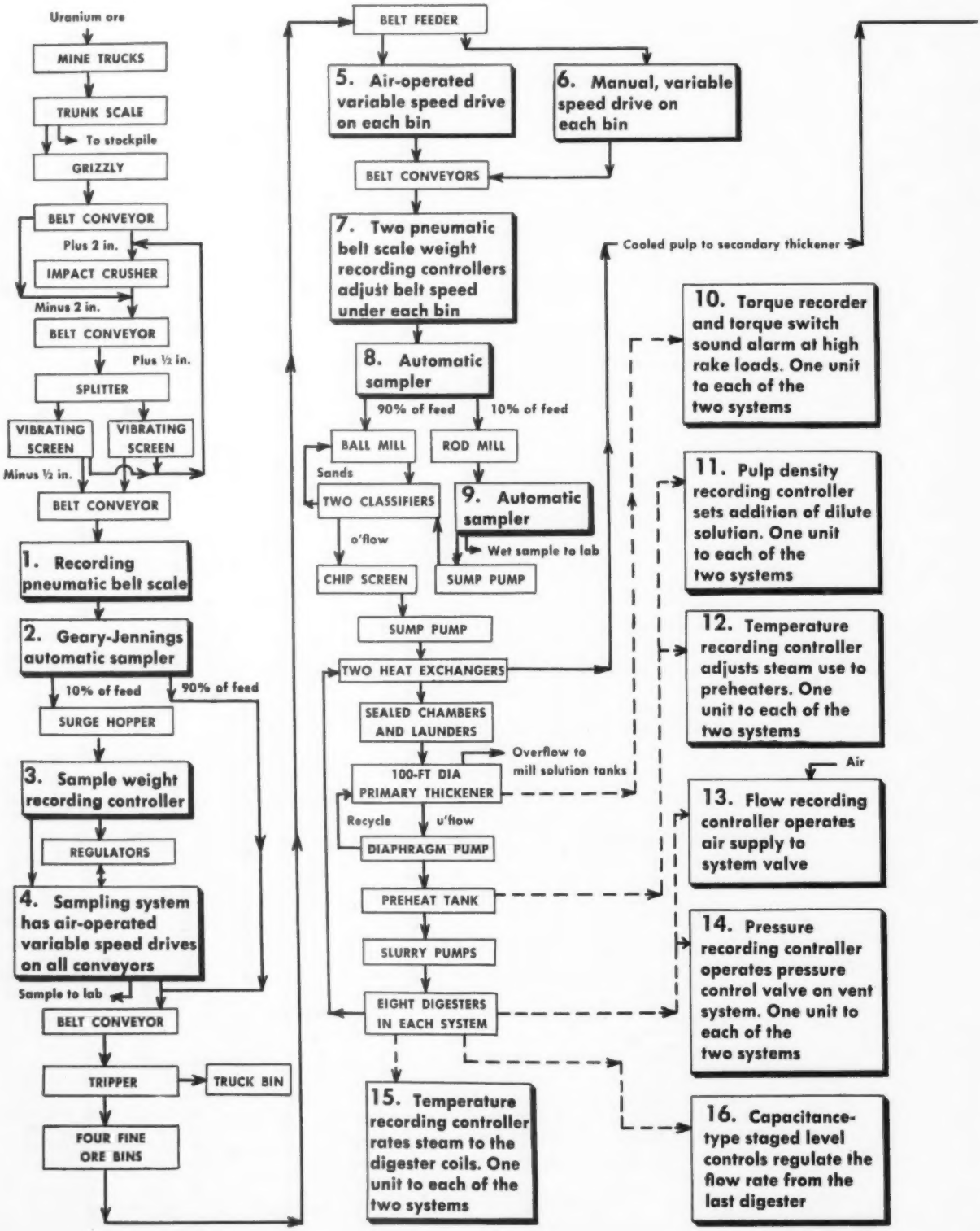
# Leach-Precipitation-Flotation Process, Kennecott Copper Corp., Hayden, Ariz.

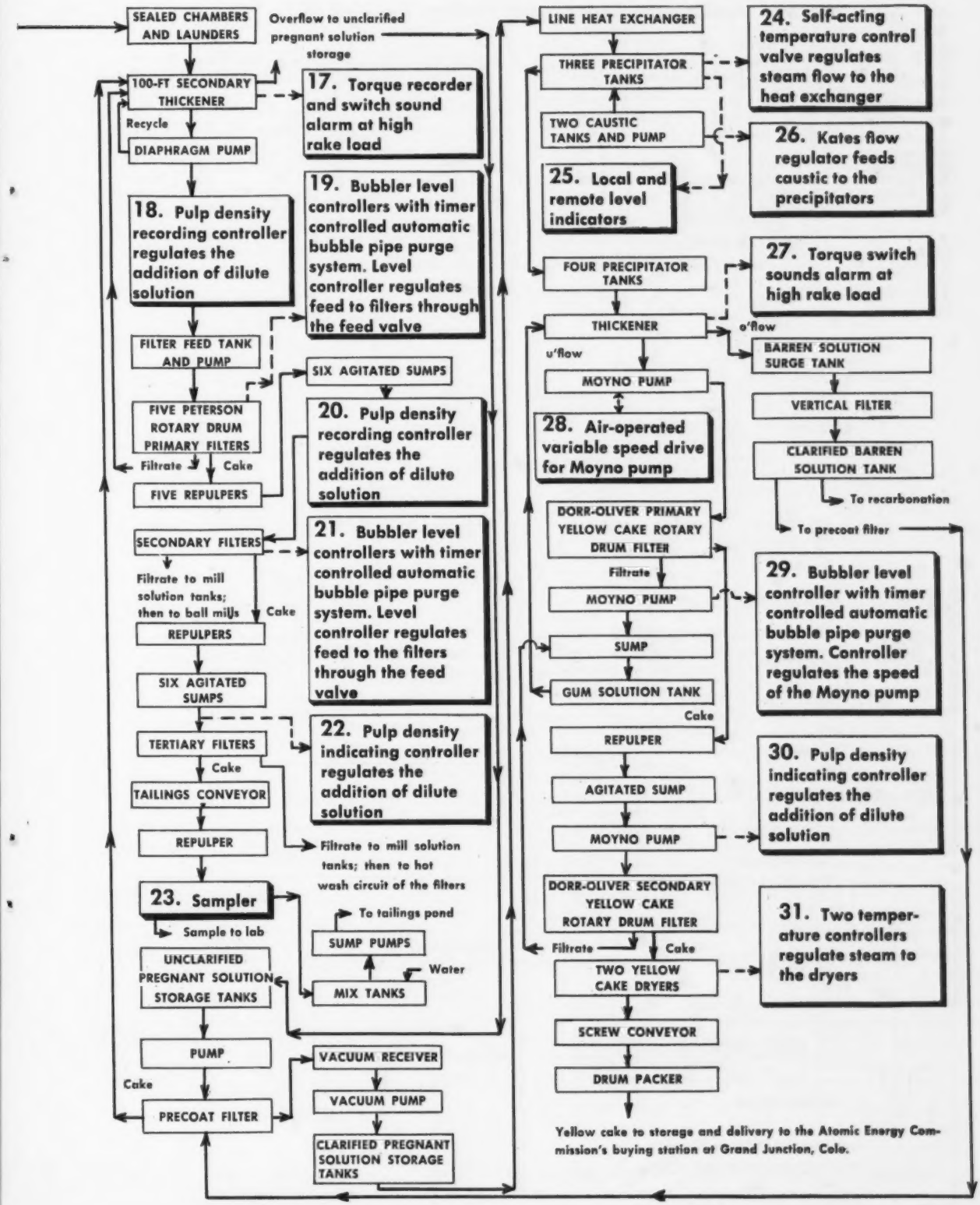
KENNECOTT'S RAY MINES DIV. recovers the non-sulphide copper minerals in the Ray ores through this process (E&MJ, June 1959) Key to the process is the sponge iron and acid plant (items 17-23). This produces fine metallic iron and sulphuric acid by roasting and then reducing pyrites which are recovered by flotation from the Ray ores.



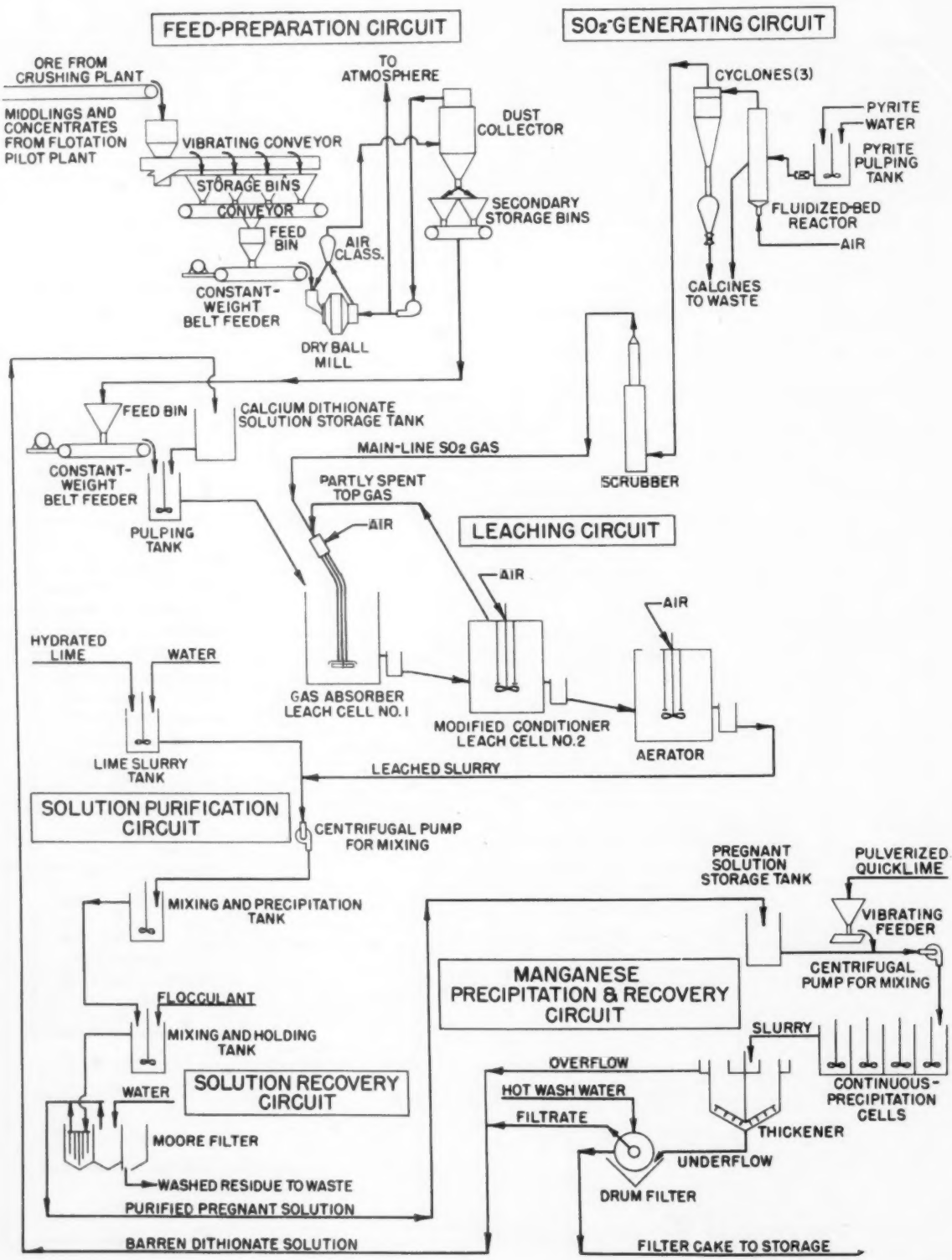

1. Four 9x12-ft rod mills
2. Four 24-ft bowl classifiers
3. Four Krebs D-20B cyclones
4. 40-ft leach tank
5. Two Fagergren precipitators, nine 66 in. cells
6. Four Fagergren cleaners, four 56-in. cells
7. Six Krebs D-20B cyclones
8. Four 12x20 ft leach drums
9. Four 12-ft washing classifiers
10. Four 8-ft washing classifiers
11. Four Fagergren conditioners, four 66-in cells
12. Four Fagergren roughers, eleven 66-in. cells
13. Four Fagergren conditioners three 66-in. cells
14. Four Fagergren scavengers, nine 66-in. cells
15. One Fagergren scalper, five 56-in. cells
16. Two 36-in. Dings magnetic separators
17. 40-ft thickener
18. Two 12-ft dia feed tanks
19. Dorr Fluosolids reactor
20. 30-ft Bruckner furnace
21. 7x40-ft Baker cooler
22. Screening plant
23. 100-tpd contact sulphuric acid plant
24. Coal and flue dust storage

## Uranium Flowsheet, Homestake — Sapin Partners, Grants, N.M.


Uranium ore
MINE TRUCKS
TRUNK SCALE
To stockpile
GRIZZLY
BELT CONVEYOR
Plus 2 in.
IMPACT CRUSHER
Minus 2 in.
BELT CONVEYOR
Plus ½ in.
SPLITTER
VIBRATING SCREEN
VIBRATING SCREEN
Minus ½ in.
BELT CONVEYOR
1. Recording pneumatic belt scale
2. Geary-Jennings automatic sampler
10% of feed
90% of feed
SURGE HOPPER
3. Sample weight recording controller
REGULATORS
4. Sampling system has air-operated variable speed drives on all conveyors
Sample to lab
BELT CONVEYOR
TRIPPER
TRUCK BIN
FOUR FINE ORE BINS
BELT FEEDER
5. Air-operated variable speed drive on each bin
6. Manual, variable speed drive on each bin
BELT CONVEYORS
7. Two pneumatic belt scale weight recording controllers adjust belt speed under each bin
8. Automatic sampler
90% of feed
10% of feed
BALL MILL
ROD MILL
Sands
TWO CLASSIFIERS
9. Automatic sampler
o'flow
Wet sample to lab
CHIP SCREEN
SUMP PUMP
SUMP PUMP
TWO HEAT EXCHANGERS
Cooled pulp to secondary thickener
SEALED CHAMBERS AND LAUNDERS
Overflow to mill solution tanks
100-FT DIA PRIMARY THICKENER
Recycle
u'flow
DIAPHRAGM PUMP
PREHEAT TANK
SLURRY PUMPS
EIGHT DIGESTERS IN EACH SYSTEM
15. Temperature recording controller rates steam to the digester coils. One unit to each of the two systems
16. Capacitance-type staged level controls regulate the flow rate from the last digester
10. Torque recorder and torque switch sound alarm at high rake loads. One unit to each of the two systems
11. Pulp density recording controller sets addition of dilute solution. One unit to each of the two systems
12. Temperature recording controller adjusts steam use to preheaters. One unit to each of the two systems
Air
13. Flow recording controller operates air supply to system valve
14. Pressure recording controller operates pressure control valve on vent system. One unit to each of the two systems

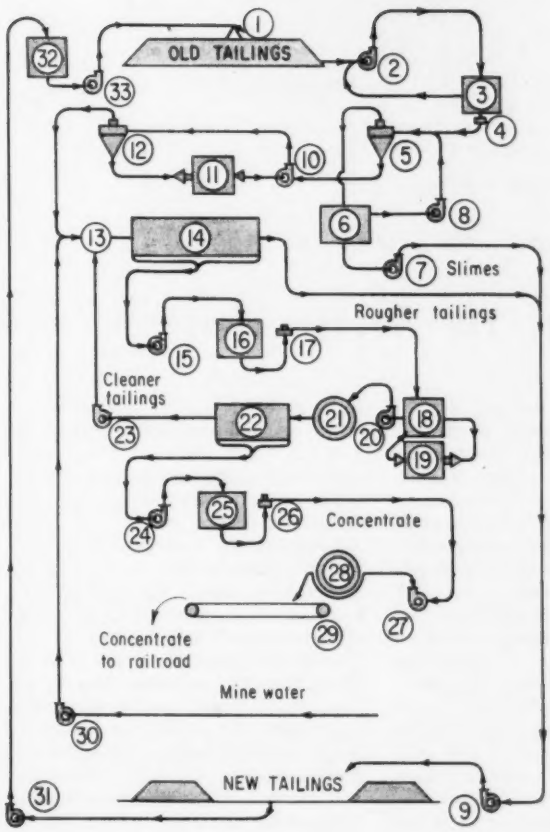

SEALED CHAMBERS AND LAUNDERS
Overflow to unclarified pregnant solution storage
100-FT SECONDARY THICKENER
17. Torque recorder and switch sound alarm at high rake load
Recycle
DIAPHRAGM PUMP
18. Pulp density recording controller regulates the addition of dilute solution
19. Bubbler level controllers with timer controlled automatic bubble pipe purge system. Level controller regulates feed to filters through the feed valve
FILTER FEED TANK AND PUMP
SIX AGITATED SUMPS
FIVE PETERSON ROTARY DRUM PRIMARY FILTERS
20. Pulp density recording controller regulates the addition of dilute solution
Filtrate
Cake
FIVE REPULPERS
SECONDARY FILTERS
21. Bubbler level controllers with timer controlled automatic bubble pipe purge system. Level controller regulates feed to the filters through the feed valve
Filtrate to mill solution tanks; then to ball mills
Cake
REPULPERS
SIX AGITATED SUMPS
TERTIARY FILTERS
22. Pulp density indicating controller regulates the addition of dilute solution
Cake
TAILINGS CONVEYOR
REPULPER
Filtrate to mill solution tanks; then to hot wash circuit of the filters
23. Sampler
To tailings pond
Sample to lab
SUMP PUMPS
Water
UNCLARIFIED PREGNANT SOLUTION STORAGE TANKS
MIX TANKS
PUMP
VACUUM RECEIVER
Cake
VACUUM PUMP
PRECOAT FILTER
CLARIFIED PREGNANT SOLUTION STORAGE TANKS
LINE HEAT EXCHANGER
24. Self-acting temperature control valve regulates steam flow to the heat exchanger
THREE PRECIPITATOR TANKS
TWO CAUSTIC TANKS AND PUMP
26. Kates flow regulator feeds caustic to the precipitators
25. Local and remote level indicators
FOUR PRECIPITATOR TANKS
27. Torque switch sounds alarm at high rake load
THICKENER
o'flow
BARREN SOLUTION SURGE TANK
u'flow
MOYNO PUMP
VERTICAL FILTER
28. Air-operated variable speed drive for Moyno pump
CLARIFIED BARREN SOLUTION TANK
To recarbonation
To precoat filter
DORR-OLIVER PRIMARY YELLOW CAKE ROTARY DRUM FILTER
Filtrate
29. Bubbler level controller with timer controlled automatic bubble pipe purge system. Controller regulates the speed of the Moyno pump
MOYNO PUMP
SUMP
GUM SOLUTION TANK
Cake
REPULPER
30. Pulp density indicating controller regulates the addition of dilute solution
AGITATED SUMP
MOYNO PUMP
DORR-OLIVER SECONDARY YELLOW CAKE ROTARY DRUM FILTER
31. Two temperature controllers regulate steam to the dryers
Filtrate
Cake
TWO YELLOW CAKE DRYERS
SCREW CONVEYOR
DRUM PACKER
Yellow cake to storage and delivery to the Atomic Energy Commission's buying station at Grand Junction, Colo.

## Manganese-Dithionate Process, U.S. Bureau of Mines Pilot Plant
## Electrometallurgical Experiment Station, Boulder City, Nev.



THE FLOWSHEET on the opposite page represents a process that the U.S. Bureau of Mines developed to treat the low-grade manganese ore in the Artillery Mountains of Mohave County, Ariz. An estimated 175-million tons are there and contain 3- to 4-% manganese. The manganese ore does not respond to flotation or other common methods of concentration. U.S.B.M. developed this flowsheet in a pilot plant at Boulder City, Nev., which it operated from May 1951 to October 1953. Sulphur dioxide acts as a solvent when it is blown into the slurry of manganese ore and calcium dithionate solution. Manganese oxides dissolve to yield a mixture of manganese dithionate and sulphate. In contact with calcium dithionate, manganese sulphate converts to manganese dithionate, and calcium sulphate precipitates. Slurry is filtered. Cake goes to waste, pregnant filtrate is treated with quicklime. Manganese hydroxide precipitates (calcium dithionate is regenerated), is thickened, and sent to storage. (E&MJ, November, 1959; U. S. B. M. Report of Investigation 5508)

## Silver Tailings Reclamation, Cia. Real del Monte y Pachuca Pachuca, Mexico




**LEGEND**

1. Six to eight hydraulic monitors sluice ore to the mill
2. Four Denver Equipment Co. 10x8-in. SRL sand pumps
3. Denver 15-ft dia agitator tank
4. Ohmart gamma ray, Foxboro controls and Minneapolis-Honeywell regulators control tonnage and density
5. Nine Krebs D-20-B cyclones
6. Two Dorr 150-ft dia thickeners
7. Two Denver 10x8-in. SRL sand pumps (Ampli-Speed regulation)
8. Ingersoll-Rand 1700-gpm pump and one Dayton-Dow 14x12-in. (3,000 gpm) pump
9. Three Denver 10x8-in. SRL sand pumps
10. Three Denver 10x8-in. SRL sand pumps (Ampli-Speed controls)
11. Marcy grate mill No 77½
12. Six Krebs D-20-B cyclones
13. Three 12x12-ft tanks
14. Three banks of twelve cells each, Denver Sub-A No. 30, 56-in. machines.
15. Denver 5x4-in. SRL sand pump
16. Denver thickener 40-ft dia and 12-ft depth
17. Denver 3-in. diaphragm pump
18. Dorr rake classifier, 21 ft 8 in. x 6 ft
19. Denver 5x10-ft ball mill, trunnion discharge
20. Two Denver 2x2-in. SRL sand pumps
21. Denver 8x8-ft conditioner
22. Four cleaner flotation machines, Denver No. 21 Sub-A, 38-in machines
23. Denver 3x3-in. SRL sand pump
24. Denver 2x2-in. SRL sand pump
25. Dorr thickener 40-ft dia and 12 ft depth
26. Denver Simplex 4-in. diaphragm pump
27. Denver 2x2-in. SRL sand pump
28. Eimco four-disk filter with 8-ft 10-in. dia leaves
29. Conveyor belt, 20 in. wide and 120 ft long
30. Ingersoll-Rand No. 8 CFV 10x8-in. pump
31. Dayton-Dow 14x12-in. pump
32. Head tank to hold water for the monitors, 38 ft 7½ in. dia and 16 ft depth
33. Two Ingersoll-Rand Type 6 GT 1600-gpm (250-hp) pumps.

THE MINING DEVELOPMENT COMMISSION of the Mexican Government is treating the old silver tailings around the city of Pachuca, using this flowsheet. The 50-million-odd tons of cyanide tailings in the Pachuca—Real del Monte district contain silver, gold and lead values estimated at 25¢ per ton (E&MJ, November 1959). The Mexican Government bought the U.S.-owned Cia. Real del Monte y Pachuca in 1947.

**THE LIFE STORY** of a tire can be read in its tread: all of the dangers it survives leave their mark. In the tire at left, the cuts which occurred around the tread are from spinning; across-the-tread cuts come from turning on sharp rocks.

## The One-Third of Haulage Cost You Can Do Something About—

# Getting the Most Out of Mine Tires

**D. P. EIGO**

**C. H. CHASE**

NEARLY A DOZEN OPEN-PIT OPERATORS, in interviews over the past 18 months on mine tire maintenance, have agreed that tires represent one-third or more of the total cost of haulage. One pit superintendent in California even went so far as to rate it one-ninth of total costs. The survey, which included major manufacturers as well as users, represents some of the best of current tire techniques.

The manufacturers themselves have given particular study to the use and care of tires in mines, and offer a great deal of specific instruction and guidance. They list the major enemies of tires as rock cuts, breaks and heat, and note that the greatest challenge to the pit superintendent is choosing the tire for his operation which runs coolest and still has sufficient tread and strength to resist rock damage.

Preventive maintenance begins in the superintendent's office, preferably with the appointment of a tire foreman. (One mine manager in the Southwest proudly showed us the date he appointed a foreman. It was at the top of a sloping curve chart of haulage costs.)

The second, and almost equally important step, is concentrating attention on maintenance of haul roads. Company after company, in our talks with manufacturers, emphasized the value of clean roadways. — Then comes explicit training of shovel operators and truck drivers. The damage done by overloading and overspeeding is ruinous. And then comes the tire foreman. In the area of preventive maintenance, the following steps are suggested unanimously by operators and manufacturers alike:

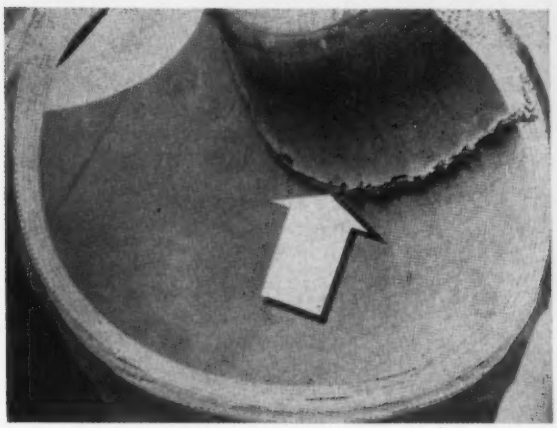
**1 Selecting the right tire is the primary step.** The best tire for a particular mine is usually a compromise. Lots of rubber and many plies, giving strength and protection, make for too much internal heat at high speeds (25 to 30 mph); but, on the other hand, thinner tread and fewer plies make the tire vulnerable to devastating damage from cuts and breaks. The tire companies provide competent engineers to consult on the problems to be found at any property. Also, the tire industry supports the Tire and Rim Assn., a group dedicated to research and standardization, which also publishes performance and application tables.

Some of the factors which enter into a choice are load, type of equipment (gas or diesel), side or end-dump bodies, condition and type of right-of-way, speed, haul distance, grades, climate and material hauled. The industry has yet to define the cut-off point which separates the short- and long haul. Firestone, for instance, places it at 1½ miles; and Seiberling at minus two. In both cases, the makers note that several assumptions of speed and load were made for the sake of establishing the distance. Goodyear, Goodrich and U.S. Rubber also note the lack of industry agreement and hesitate to make any estimate because of the load, road and speed factors—all impossible to generalize.

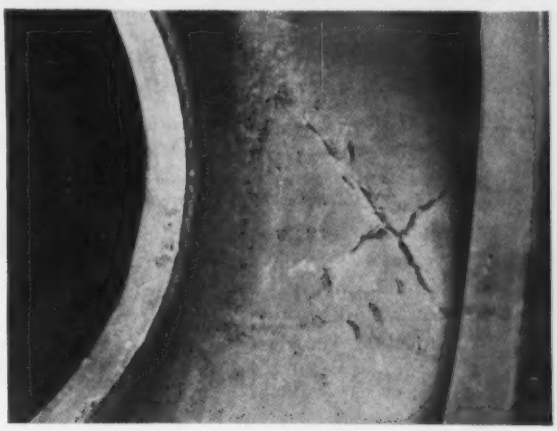
Tire treads are designed to fit the demand for traction, flotation and toughness. Tire cord bodies are designed to withstand bruising and heat buildup, and to provide flexibility and strength. The following are general

Mr. Chase, a former member of the editorial staff, is now district manager, McGraw-Hill mining papers, Chicago.

**THE GREAT VARIETY** of tires available from the leading manufacturers have special tread designs for special jobs. From the left: a hard rock lug type; the earthmover type, for high flotation; on-and-off-highway type; an ideal front wheel type which turns easily and stands up well; and a new "special" type with steel cord breakers to resist cuts.



**OVERLOADING** or under-inflation can produce the above results of excessive flexing of the tire walls. Heat builds up, too.



**THE X-BREAK,** one of the most common and most damaging types of injury, is caused by a sharp impact when overloaded.

recommended designs for various applications:

**a)** Mining operations (30 mph). Open pits, quarries and other "sharp rock" operations require a more "closed" design, a wide tread width for maximum contact area, and triple-thick sidewalls. Tread and sidewall rubber must be tough and cut-resistant; carcass strength must be sufficient to withstand terrific loads and the high operating temperatures which come from speed. These are generally known as "rock tread" tires.

**b)** Traction operations (30 mph). A drive wheel that operates in soft, wet soils where high traction is needed requires a more open design so that the treads may "clean" more easily. Thus, the "excavator" type has heavy reinforced lugs which bite deeply.

**c)** Earth moving operations (30 mph). The well-known "earthmover" type has free rolling wheels and needs tires which are self cleaning and have high flotation with maximum deflection and a low rolling resistance.

**d)** Off- and on-the-highway operations (30 mph). Combined service calls for a tire with self-cleaning lug design and a stone ejector. It must have heavy sidewalls (double) and tough, cut-resistant tread compounds.

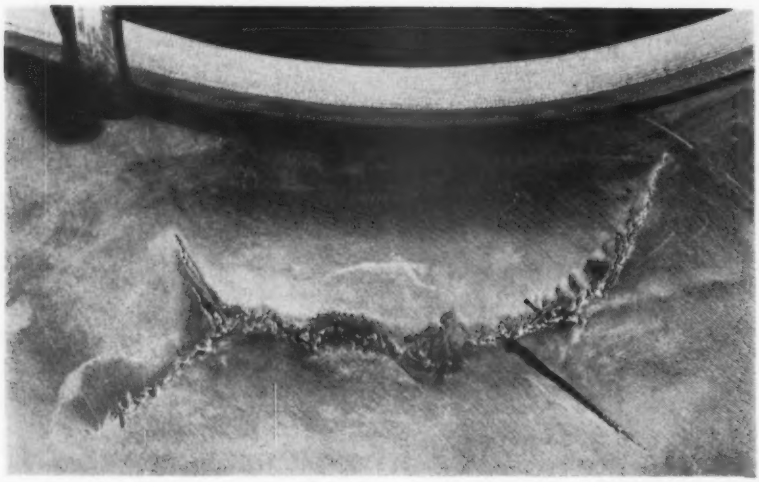
Greater stability, more "rubber on the road," less slip and more tread volume—all in a low-pressure tire—have been achieved in the "wide-base" tire. This design, well suited to mining work, is a product of manufacturer research into problems of rock cutting.

Mine operators records (to be discussed later in this article) supply guidance for choosing replacement tires. For example, one Arizona operator's statistics show that in over-all cost, rayon tires are cheaper than nylon cords. Others can cite figures which show the long-term advantage of tube tires over tubeless or of a specific kind of tread.

Extra tread tires command a 12 to 15% premium, but offer a lot of additional cut protection and certainly more wear. This may, at a given operation, offset their being hotter running—a result of the added insulation of more rubber. Present indications are that they do well, particularly in the colder climates, and that acceptance is gaining in warmer spots.

In the tubeless vs tubed controversy, several mining companies have sacrificed the cooler running benefit of tubeless because, in the words of one, "As soon as we've made one or two repairs, we have to put a tube in it anyhow. So we start with a tube and avoid the higher initial price of the tubeless." Tire people, however, insist that care, proper tools and recommended technique will give a tubeless tire repeated uses without having to resort to a tube. Although a direct comparison between highway and off-highway operations cannot be made, tubeless tires are coming into wider use on large highway rigs and operators have found it worthwhile to polish their shop practices to get the intended use out of the tubeless tires.

Offsetting the difficulty which improved practice entails in repair of tubeless tires are several bonuses. In many off-road operations it is claimed that 90% of the vehicle down-time for tire trouble is because of tubes and flaps. Another estimate is that 6% of all vehicle downtime is because of tires; so, if we eliminate tubes and flaps, that figure can be reduced to 1%, and the availability of the vehicle



**OVER-INFLATION** is as likely a cause of an X-break as is overloading. Frequent checking by the driver, the tire foreman and his crew are the best protection.

**THE TWO EVILS** of inflation are equally expensive. A study of the wear pattern will indicate the type of error. Speed squares the effect of damage on a tire.

for profitable use is increased by 5%.

The soft inner lining of a tubeless tire will, in the case of small punctures, either prevent or slow the loss of air. This self-sealing tendency can be important in reducing not only damage to tires from sudden loss of air, but the likelihood of blowouts. And, of course, should the operator's efficiency with tubeless tire repair approach a peak of perfection, he may be able to almost eliminate the expense of stocking and repairing tubes. While that utopian state may be beyond practical reach, there are certainly lesser goals which may make the effort financially attractive.

Tire manufacturers have all contributed immensely to the recent great advances in their products. Competition is intense and operators will frankly use a temporary gain by one maker as a lever to lift the performance of a competitor.

**2 Overloading a tire can kill it**—tube, carcass and all. Sometimes an operator will mistakenly overload his tires in the belief that the gain in time and capacity will pay for the expense of shorter tire life. A margin of safety is built into all tires, and even severe overloads usually have no immediate effect. But the accumulated effect of such treatment will be seen shortly in ply and tread separation, circumferential flex breaks in the carcass, and radial breaks in the sidewalls.

An overload will cause a tire to flex excessively and develop high internal heat and high pressure. It is true that sufficient reserve strength is built into tires so that pressure may be raised 5 to 10 lb above the limits in load and inflation tables to offset overloads not exceeding 10% of maximum recommended loads. But when overloads exceed recommended loads by more than 10%, the use of extra ply rating is definitely in order. Stronger ply bodies will permit higher inflations to support the greater loads, but add to the heat.

In selecting a ply rating for a given load it is well to choose one in which inflation can be kept at a relatively low level to soften impacts which cause bruises and cuts.

Every tire maker surveyed mentioned overloading as one of the top causes of tire failure and one noted that it will cause the carcass to break down and cause uneven wear. He also cited the importance of proper weight distribution. A parallel hazard from overloading is the increased likelihood of spillage, with its own threat of tire damage.

**3 Improper inflation is the magnifier of all lesser evils;** exaggerating a minor bump to a crushing blow, centering wear to an unbearable point, converting work day heat to the bursting point. A properly inflated tire provides free, uniform pressure on the tread. Inflation standards for every tire, based on load, speed and ply rating, have been set by the Tire and Rim Assn. On a given job, a list of proper inflations should be available to the tire maintenance men, along with a tire gage regularly calibrated to a master gage.

There is no spring in an over-inflated tire. Proper inflation supplies a cushion to shock, and in that condition has its greatest resilience. When an over-inflated tire takes a shock, part of it is transmitted to the axle, but the biggest part is felt in the small area which is strained by high air pressure. The damage is usually in the form of an X-break (see illustration). A tire over-inflated to compensate for an overload is in especially bad condition since it must not only support the added weight but the added pressure. An over-inflated tire will almost always make too-narrow contact with the road and put premature wear on one tread area.

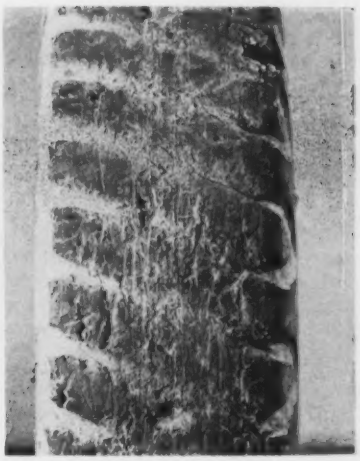
Even when properly inflated, off-road tires deflect more under load than do highway tires. Frequently the bulge is noticed with alarm, and a driver may inflate the tire to where "it looks all right," but is then susceptible to severe damage. "Bleeding" a hot tire is even more destructive.

Off-the-road tires are designed as low pressure tires. But pressure that is below the design pressure is even more damaging than pressure that is too high. Heat generated by too much flexing in an under-inflated tire deteriorates the carcass and causes separation of plies and, sooner or later, a blowout.

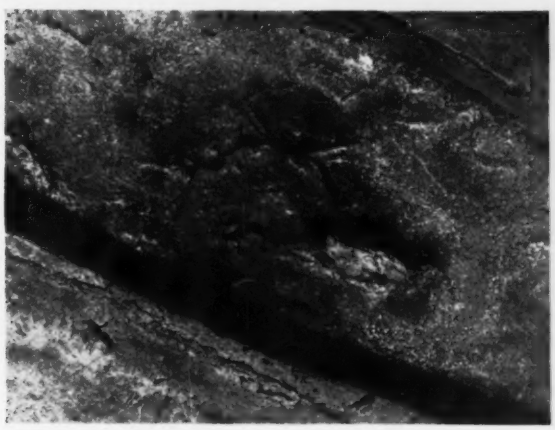
The relationship between speed, load and inflation must be emphasized. What is correct for a given load at 15 mph can be disastrous for the same load at 30.

Air pressure should thus be checked and corrected only when the tire is cool. Temperature and pressure will then equalize. It is possible for pres-

**NORMAL DEFLECTION** of an off-the-highway is wider than on highway tires. Tires should not be inflated to visually "justify"; the gage is the only sure guide.



**SOME SLIPPAGE** is bound to occur but careful checking can keep it down.



**SKIVING OUT** a small cut reveals a small stone trapped in the wound. If the stone were not removed, and the skiving not done, damage to the cord body would rapidly follow. Skiving keeps other stones from entering an old cut and boring in.

sure to build beyond 20%, in which case some change in load, speed or length of haul must be made.

**4** **Off-the-highway tires** are designed to operate in the 10 to 30 mph range, and "stepping on it" can blow out a new tire in a matter of minutes. No conceivable time saving could equal the cost in tires.

And shock damage increases as the square of the speed: a blow taken by a tire at 30 mph will be nine times more damaging than the same blow at 10 mph. High temperatures, which can result in ply separation or separation of tread and breakers from the carcass may develop if speeds exceed 30 mph for more than short periods; if the haul is long (two miles or more) and is taken at plus 25 mph.

Temperatures of 250° are enough to seriously damage tires, although the actual failure may be delayed. A small initial separation chafes and eventually enlarges until weakening and failure occur.

Carefully trained, conscientious drivers can prevent much damage. Here are a few "rules of the road."

**a)** Drive according to road conditions. Bumps and chuck holes, taken fast, are ruinous to tires.

**b)** Avoid sudden stops, rocks, bumps, snags and depressions.

**c)** Don't spin the wheels on a start or on a grade. (Here, an overinflated tire will increase the tendency to spin.)

**d)** Slow down on curves to avoid flexing and ply separation.

**e)** Don't bump rear tires against a barrier in unloading.

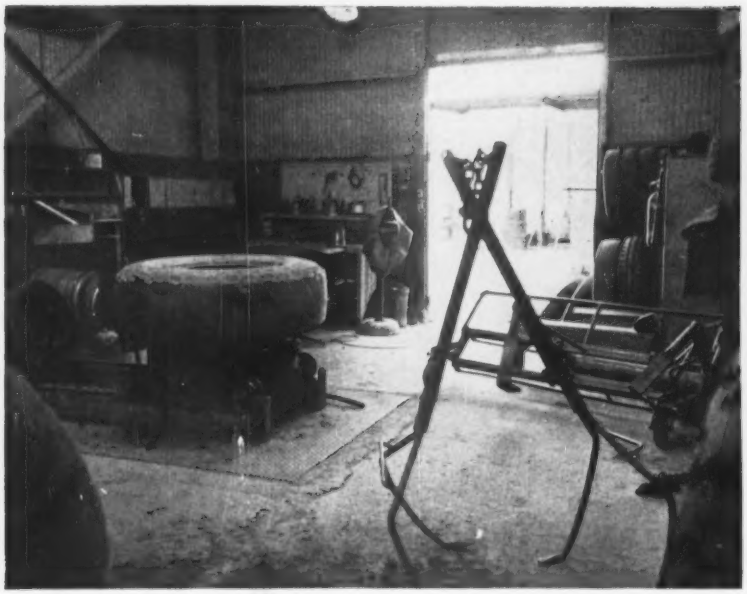
**f)** Oil, gas and grease will harm rubber. Avoid them.

**g)** Report any damaging mechanical condition.

**h)** Avoid sharp turns on sharp rocks. (Power steering can be particularly damaging when the truck is turning or backing in sharp rocks.)

**5** **Responsibility for the fifth,** and perhaps most important single area of preventive maintenance rests, as was pointed out earlier, in the pit superintendent's office. Most of the mines visited—and every manufacturer—emphasized the condition of the haulage road and the loading and dumping areas as a key factor in lengthening tire life.

The biggest single expense in off-the-road tires is from rock cuts and breaks. The best of practices and policies in the shop will be largely wasted unless the operations person-



**A GOOD TIRE SHOP** need not be complex, but it must be clean and neat, dry and safe. Tire (above) rests on breaker carriage, lifter is at center, holder at rear.

**A ROCK EJECTOR** on the truck body is a favorite guard against this.

nel keep the roads graded and clear of rocks. In the more efficient U.S. mines, overloading is carefully watched and in most places a scraper clears spillage promptly.

Rocks inevitably fall from loads on the road, and the wiser mines maintain a grader patrol which also watches for spillage. One model mine even has a man on the roads with a pickup and shovel—and they claim he has more than paid his expenses.

Severe pot-holes and bumps at any point along the right-of-way must be eliminated. They are the source of the X-break, which may go undetected until the tire blows. Good grading, too, means good drainage. Its opposite means pot-holes (and the sharp, unseen rocks which unfailingly lurk within them) and the presence of water (wet rubber cuts three to four times as easily as dry).

Surfacing material varies from mine to mine in the group surveyed and, of course, depends upon local rock conditions and policy. Where abrasion is serious, fine crushed ore and mill tailings are in common use. Fines not only serve as a cushion, but they help hold down heat. Crushed ore is one of the happiest choices for pit roads since, as one operator said, "It all winds up in the mill anyhow." At the same mine, and at many others, water sprinkling trucks travel the roads to keep dust down and also to cool the traveling surface. (The wet rubber threat here is obviated by the cushion of fines.)

## In the Tire Shop—

IN A HEAVYWEIGHT BOUT with an adversary as tough as tire destruction, even a well-trained battler must expect to lose a couple of rounds. The following record of one year's tire removals is from an open pit iron mine, obviously fighting a sharp rock condition:

| | |
|---|---|
| Worn out tires | 30.4% |
| Carcass breaks and cuts | 42.6 |
| Too many repairs | 8.7 |
| Repair failures | 7.0 |
| Adjustments (separation) | 2.3 |
| Others | 9.0 |
| | 100.00 |

Assuming that all of the objectives in the first section of this article are being pursued, more effort must be put forth in the tire shop itself, and by the tire crew in the pit.

Nearly every mine visited in this survey makes a regular daily check of all tires—inflation by gage, condition by visual. (Three of the pits make as many as three inflation checks per day.) In two pits, the roving lubrication truck crew is also responsible for inflation checks, and the tire foreman makes a personal check of each tire at least once a week.

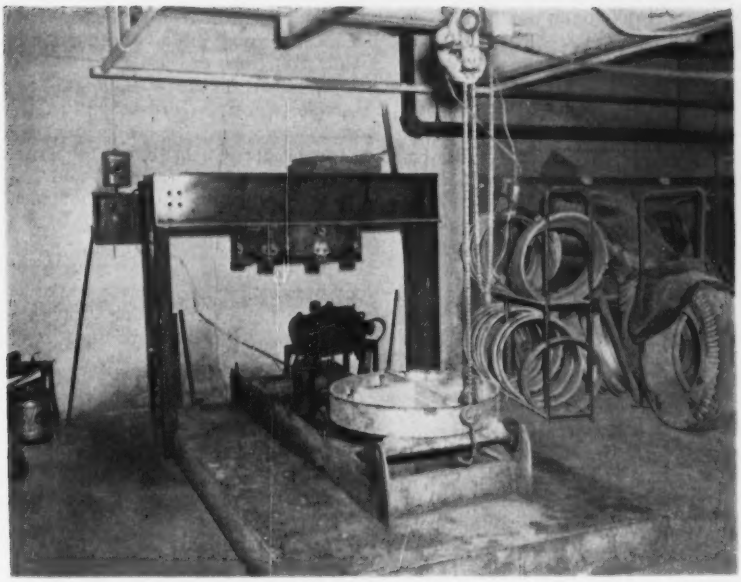
A talent for inspection carries far beyond the routine daily check; it is the key to matching and rotating tires.

Dual tires must be well matched. Bad matches will create overload on one tire and destructive "scuffing" on the other. The best time to match duals is after they are on the rims and inflated, but not yet on the vehicle. Circumference can be checked with a steel tape or a string gage. On mine tires, circumferences of any set of dual tires should not differ by more than 1½ in.

If the tires are already on the truck, duals can be checked with the string gage, a large pair of calipers, or a wooden straight edge long enough to lie across the treads of all four tires. Diameters of any pair should not be more than ½ in. apart. Never inflate dual tires to different air pressures if a diameter check fails to pass the test. Each pair must be at exactly the same pressure.

An experienced tire foreman at a copper pit adds this advice, "Try to match tread depth exactly when you're putting tires on. Tires can fool you—the carcass will grow and compare favorably with a new tire. You have to measure tread depth and the depth of the tire from the rim out."

Proper spacing of duals is another thing to watch. Tight spacing reduces cooling air flow and increases the possibility of sidewall abrasion when the load is heavy. On the other hand,



**A HOME-MADE BREAKER** in the Southwest uses a welded carriage to move the mounted tire under a hydraulic press where a 20-ton jack pushes rim out of the tire.

## Inspection & Correction

wide spacing will cause dragging and scuffing on the outside tire on curves and turns. A Tire & Rim Assn. handbook will give the recommended width of space, which incidentally will be narrower for tubeless tires.

Rocks lodged between duals are a constant source of damage. Some operators use rock ejectors mounted on the truck, others do it manually.

Rotation of tire position depends on local conditions, equipment and policy (based on experience and accurate records). If the tires on one vehicle are all of a size, general practice is to start the new ones on the front, working them toward the rear as traction and trailing tires are removed from service. Some properties avoid putting a recapped tire on a front wheel. At one property in Arizona, wear is most pronounced on the left front wheel, and candidates for recapping are found there. An "easy" start is often recommended for all tires, to give the cord body a chance to stretch and adjust.

### It's Not Just Tires

The tire foreman's knowledge and responsibility won't let him confine his interest to tires alone, for tire trouble may well originate elsewhere on the truck. A sagging axle will speed wear on a single tire, and on duals will flatten the tread on the outside tire and "cup" the inner. Axle checks are made when the truck is fully loaded.

A brake drum out of round will wear the cord body in a single spot, or, as is more likely if the trouble is not corrected, in several single spots. Brakes which are not equalized can cause a wheel to lock and intensify tire wear.

Loose or worn bearings will also cause flat spots across a tread even if the irregularity is relatively slight.

Wheel alignment is critical. If the foreman spots uneven wear despite proper inflation and proper loading, he will do well to check for the following mechanical defects:

**1) Toe-in:** the wheels on the same axle are closer together in front than in the rear. Feathered edges will appear on the inside edge of the skid design, usually more pronounced on the right tire than the left.

**2) Toe-out:** the opposite condition. The feather will be on the outside edge of the skid design.

**3) Camber:** measures tire tilt. Positive camber is when the wheels are closer at the bottom than at the top; negative is the opposite situation. Excess camber causes slippage between the center and side sections of the tread and tires wear heavily on one side.

**4) Caster:** measures the backward tilt of the kingpin. Too little caster causes the wheel to wander and weave, and causes spotty wear on the tread. Too much will cause wheel shimmy. Unequal caster will cause side pull and uneven tire wear.

### Repair and Recapping

A well executed repair program can greatly reduce overall haulage costs. But it means frequent and expert examination of tires, followed by action to correct the observed damage.

A nearly worn out tire will not justify much in the way of repair: but there is evidence that many operators just don't realize what can be done to get an apparently damaged tire back onto the road for a long, useful life. Cold sectioned tires, for instance, can be recapped and tubeless tire punctures up to ⅜-in. can be repaired without removing the tire from the wheel.

The cold section is applied by cutting a flat cone-shaped piece out of the damaged tire, including the damaged cord section, and can be made in either sidewall or tread. The limitation imposed by the manufacturer is that the lateral extent of the cut or break not exceed one-third of the tread width.

After cutting, the cavity is coated with a self-vulcanizing compound and then filled with a cold, natural rubber substance which soon loses its plasticity and becomes integral with the surrounding rubber and the "section" itself. The section is a piece cut, or "skived" from a used tire (and hence composed of cords which have already stretched in use) and must be oriented to the tire cord. Ordinary use on the truck makes the vulcanization complete. In sectioning, as in all repair operations, extremely clean, dry conditions are maintained, and the section is, of course, buffed smooth before the tube is inserted. (Remco Inc., a manufacturer of sections, has also introduced a cold section with plies of thin, woven synthetic cord, which produces a thinner and, the firm says, stronger repair than the old skived sections.) It should be noted that the section is distinct from the temporary repair which has been known for years as a "boot," although many mine tire men may use the older name.

Cuts in the tread rubber must be treated quickly. Skiving out the cut is always necessary to avoid a stone re-

maining in the rubber, where it will soon penetrate the cord body. Even if no rocks are imbedded in the cut, they soon will be unless it is skived. If examination shows that the cord body is about to be damaged, the tire should be removed and sectioned. At the same time, all other cuts, big and small, can be repaired.

The economics of recapping have until recently been open to question. The consensus probably favors it, but some mines, under local conditions and based on their individual experience, have abandoned it.

But, with the increasing use of wide-base, extra-tread tires within the past two years, more operators are finding that tires can take repairs better than was thought possible. Probably the net effect is a favoring of the recap over the policy of run-to-destruction. Improved service by recap outfits has also contributed. In fact, two western recap firms visited in the survey have taken over a part of what would normally be the mines' record keeping function.

## When to Recap?

All of the domestic mines surveyed farm out their recapping. The foreman must make the decision of when —based on past performance of a given tire in type of service, location, type of wear and future placement of the recap. Beyond what amounts to policy, which is based on records, the decision must be based on visual inspection. One Arizona mine looks to the front wheels as the best source of recappable rubber. A California operator will draw from any wheel position but stipulates, "When the lug is gone, you're inviting trouble if you don't recap immediately."

If the recap man is nearby, his advice and counsel can guide a less-experienced foreman. In several open pits, the outside recap man has access to the tire shop and, with the okay of the foreman, will go through a rack of used tires and select the ones which he can recap, take them away, make the repair and return the tires, all with a minimum of record keeping and time lost.

The majority of the mines visited keep new tire stocks low; rarely more than one complete set of a given size. (By contrast, Toquepala, in Peru, maintains an eight-month inventory. Toquepala, too, does its own recapping, on a Lodi T-98 mold, which can handle a 6.50x16 and a maximum of 37.5x33).

A second part of this article, which will be published subsequently, will treat the whole subject of tire records. The following data on records is typical practice in the Southwest, though, and illustrates the information a tire foreman requires:

Of approximately 245 tires under daily check, about 10% are either being repaired, or are ready for replacement. Individual records are kept to give the complete history of each tire; the foreman files a quarterly summary to management which shows:

a) number of tires scrapped, by brand

b) average miles run; before recap and after recap; or as run-to-destruction, as the case may be

c) average cost per mile in each stage of a tire's life, and average per-mile cost for life of the tire.

Most mines handle all their own repair work. Equipment needed for an adequate maintenance shop is made up of a few fairly standard items: compressed air (it must be dry), a monorail hoist (about 1-ton capacity), truck jacks and supports, wrenches, tire irons, hammers (rubber and bronze or babbitt), pries, valve stem straighteners, air operated tire spreader with lift, tube dunker, gages (with a master gage for periodic checks), air chucks, and a portable safety cage for inflation.

## Tire Practice

Various methods of demounting tires are used in Western mines; most of them simple and designed to take the best care of the tire. One such mine uses a home-made stripper which has a carriage to move the mounted tire under a hydraulic press; a 20-ton jack pushes the rim up out of the tire; the jack is retracted and the carriage and tire rolled back. The jack is powered by an old engine fuel pump. For field demounting, there is a variety of hand-held hydraulic tools.

A vacuum deflator is in use at one mine tire shop. It is simply a connection between the tire tube and an engine intake manifold which, with the engine running, can cut about 15 minutes of the time it normally takes to deflate a tire.

In any tire shop, cleanliness is fairly close to godliness. Dirt, perspiration, oil, grease, gasoline or just plain moisture can spell ruin for a tire repair. When a tire is removed from a rim, the rim should be cleaned of all oil, grease, rust and dirt and then painted with zinc chromate, red lead or a good grade of aluminum paint. Rims should also be watched for damage. A bent-out flange, for example, will allow tire beads to distort.

The inside of a tire must be clean and smooth before mounting, and, in the case of tubeless, must be mounted with extreme care paid to the bead. An approved tire lubricant, judiciously used, speeds up mounting, promotes sealing on tubeless, reduces mounting and demounting damage and generally protects rims and tires.

## "The Bull Gang"

Getting a truck back to work after a tire change must be one of a shop's main aims in life. One large operator has a "bull gang" of two men per shift in the tire-change shop, ready for any truck with a flat or damaged tire. Twenty minutes for an inside flat is an easy mark there. Every shop has its own tricks. In the same shop, the truck itself is used to help remove a rear tire.

An 8 ft long, 6x6-in. jackpost is set upright on a footing, under the lip of the dump body. The body is raised until the lip meets the jackpost. The crew stands clear while the dump mechanism lifts the rear wheel against the resistance of the jackpost. When the wheel is high enough, the mechanism is reversed, the axle set down on wooden blocks and the jackpost removed.

The same shop has a simple procedure for demounting a tubed tire: the split ring and flange are removed from the outside face of the rim. An anvil (really a modified scrap rim) is placed on the floor and the tire is rolled up to it and pushed over so that the rim strikes the anvil—the sudden jar breaking the bond between the rim and tire and starting the tire. Then, with the rim flange uppermost, a chain yoke around the rim can be pulled by a monorail hoist to pop the rim.

A second article on mine tires will appear in a future issue of E&MJ; discussing case histories and showing typical record systems. The authors are indebted to the Firestone Tire & Rubber Co., B. F. Goodrich Co. and Goodyear Tire & Rubber Co. for illustrations used in this article, and to all of the above companies, plus Seiberling Tire Co. and U.S. Rubber Co. for great assistance. We are most indebted to the open pit mines, which offered the greatest cooperation and hospitality and the various tire foremen and pit crews. They, and their records, tell the story as well as it can be told.

# E&MJ's

# 1960 BUYING DIRECTORY

THE LISTINGS IN THE FOLLOWING PAGES contain a completely revised handy spot-reference of modern equipment and services that will help you do your job more efficiently and profitably.

The Buying Directory is divided into the three following sections:

1. **Product Classification**
2. **Manufacturers' Index**
3. **Advertisers' District Sales Offices**

**Product Classification.** All of the mining industry's major companies have listed just what equipment or services they offer. This listing has been alphabetized both by item and company and cross-indexed to help you to quickly and easily find the product or service you want.

**Manufacturers' Index.** Here, in alphabetical order and with full mailing address, are listed the manufacturers whose company names appear in the Product Classification.

You can get more information about a given product or service by checking the advertisement page numbers which also appear in the Manufacturers' Index. These pages contain information which could not be included in the Product Classification, but which the manufacturers want you to have. In each of the first two sections, advertisers are indicated by bold face capital letters. Page numbers are only listed in the Manufacturers' Index.

**District Sales Offices.** This section is here for your convenience in getting more information about a given product or service and for the purchase of equipment through the handiest source.

If you're planning a new project or just revamping an old one, or purchasing modern equipment, you can get the most out of the Buying Directory.

Check the Product Classification for the manufacturing or service company which will answer your needs.

If the company appears in bold face, the Manufacturers' Index will give you not only the address of the company, but the page on which that company's ad appears in this issue. Check the ad for more information about the product. And, if you're interested in the advertiser's product, you'll find the listing of district sales offices very convenient. Main office addresses also appear in this section.

If the name appears in light face type, you may obtain the address from the Manufacturers' Index.

# PART I—

# Product Classification

## A

### 1 Abrasives — *also see* Carbide; Diamonds

Aluminum Co. of America
American Coldset Corp.
American Optical Co., Safety Products Div.
**AUTOMATIC VULCANIZERS CO.**
Bay State Abrasive Products Co.
Black & Decker Mfg. Co.
Exolon Co.
Industrial Air Products Co.
Macklin Co.
Minnesota Mining & Mfg. Co.
Norton Co.
Precision Grinding Wheel Co. Inc.
**SMIT, ANTON & CO.**
**WHEEL TRUEING TOOL CO.**
Wheelabrator Corp.

**(Acetylene Generators —see Gas Generators)**

### 2 Aerators

Bin-Dicator Co.
Booth Co., Inc.
Chase Brass & Copper Co.
**DORR OLIVER INC.**
**EIMCO CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Infilco Inc.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Permutit Co. Div., Pfaudler Permutit Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 3 Aerial Cable Tramways —*also see* Excavators, Dragline Tower

**BETHLEHEM STEEL CO.**
Interstate Equipment Corp.
Lidgerwood Mfg. Co.
**MACHINERY CENTER INC.**
**RIBLET TRAMWAY CO.**
**ROEBLING'S, JOHN A., SONS DIV., COLORADO FUEL & IRON CORP.**
**SAUERMAN BROS. INC.**
Superior-Lidgerwood-Mundy Corp.

**(Aerial Towers—see Booms & Towers, Extensible)**

**(Agglomerating—see Nodulizing; Sintering; Water Clarification)**

### 4 Agitators & Mixers, Gas

**BETHLEHEM STEEL CO.**
Christian, J. D., Engineers
**GENERAL AMERICAN TRANSPORTATION CORP.**
**MIXING EQUIPMENT CO.**
Morehouse-Cowles Inc.
Philadelphia Gear Corp.

### 5 Agitators & Mixers, Liquids & Slurries—*also see* Flotation Machines; Scrubbers

Abbé Engineering Co.
**BETHLEHEM STEEL CO.**
Booth Co., Inc.
Christian, J. D., Engineers
Crossley Machine Co.
**DIESEL ENERGY CORP.**
Denver Equipment Co.
**DORR OLIVER INC.**
**EIMCO CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Graver Water Conditioning Co., Union Tank Car Co. Div.
Gray & Co. Inc.
**HARDINGE CO., INC.**
Infilco Inc.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MIXING EQUIPMENT CO.**
Morehouse-Cowles Inc.
**MORSE BROS. MACHINERY CO.**
Ogden Iron Works Co.
Philadelphia Gear Corp.
Santa Fe Tank Div., Fluor Products Co.
U. S. Stoneware Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**
**WESTERN MACHINERY CO., WEMCO DIV.**

### 6 Aircraft

Beech Aircraft Corp.
Cessna Aircraft Co.
Cochrane Corp.
Cutler-Hammer Inc.

### 7 Air Compressors, Movable & Portable

**ALLIS-CHALMERS MFG. CO.**
**ATLAS COPCO**
Bitco, Inc.
**CHICAGO PNEUMATIC TOOL CO.**
Essick Mfg. Co.
**FAIRBANKS, MORSE & CO.**
**GARDNER DENVER CO.**
Imperial-Cantrell Mfg. Co.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Midwestern Engine & Equipment Co.
Schramm Inc.
Solar Aircraft Co.
**STEWART-WARNER CORP. ALEMITE DIV.**

### 8 Air Compressors, Rotary

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Beach-Russ Co.
Bitco, Inc.
**BROWN BOVERI CORP.**
**CHICAGO PNEUMATIC TOOL CO.**
Fuller Co.
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Midwestern Engine & Equipment Co.
Nash Engineering Co.
Roots-Connersville Blower Div., Dresser Industries Inc.
Wagner Electric Corp.

### 9 Air Compressors, Stationary

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**ATLAS COPCO**
**BROWN BOVERI CORP.**
Bury Compressor Co.
**CHICAGO PNEUMATIC TOOL CO.**
Essick Mfg. Co.
Fuller Co.
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Lincoln Engineering Co., Div., McNeil Machine & Engineering Co.
Long-Airdox Co., Marmon-Herrington Inc.
Midwestern Engine & Equipment Co.
Nash Engineering Co.
**Pennsylvania Pump & Compressor Co.**
Roots-Connersville Blower Div., Dresser Industries Inc.
Schramm Inc.
Westinghouse Air Brake Co., Ind. Products Div.

### 10 Air Compressor Aftercoolers

American Standard Industrial Div.
**BROWN BOVERI CORP.**
Carrier Corp.
**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
Johnson Corp.
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Pennsylvania Pump & Compressor Co.
Schramm Inc.
Westinghouse Air Brake Co. Ind. Products Div.

### 11 Air Line Oilers

**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Rockiron Co. Ltd.
Schramm Inc.
**STEWART-WARNER CORP., ALEMITE DIV.**
**THOR POWER TOOL CO.**
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**
Wilkerson Corp.

### 12 Air Motors

**ALIMAK CORP.**
**ATLAS COPCO**
Boyles Bros. Drilling Co., Ltd.
**CHICAGO PNEUMATIC TOOL CO.**
**EIMCO CORP.**
**GARDNER DENVER CO.**
Gray & Co., Inc.
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**

Minneapolis - Honeywell Regulator, Brown Instrument Div.
Rockiron Co., Ltd.
Taylor Wharton Div., Harsco Corp.
**THOR POWER TOOL CO.**

**(Air Preheaters — *see* Heaters)**

### 13 Air Receivers—*also see* Tanks

**BETHLEHEM STEEL CO.**
**CHICAGO PNEUMATIC TOOL CO.**
Eastern Steel Plate Fabricators Inc.
Imperial-Cantrell Mfg. Co.
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
Ogden Iron Works Co.
Remington Arms Co. Inc.
Schramm Inc.
Simmons Boiler & Machine Co.
Vogt, Henry, Machine Co.
Westinghouse Air Brake Co., Ind. Products Div.

**(Air Valves — see Valves)**

### 14 Amalgamating Process Equipment (Special) — does not include standard auxiliary equipment

Denver Equipment Co.
Engelhard Industries Inc.

**(Ammeters & Voltmeters —see Meters, Electricity)**

**(Anemometers—see Meters, Fluid)**

**(Arch Plates—see Mine Supports)**

### 15 Arresters, Lighting

**DIESEL ENERGY CORP.**
General Electric Co., Apparatus Sales Div.
Line Material Industries, McGraw-Edison Co.
**OHIO BRASS CO.**
Union Switch & Signal, Westinghouse Air Brake Co.
**WESTINGHOUSE ELECTRIC CORP.**

**(Assaying—see Laboratory)**

**(Autoclaves—see Tanks)**

# B

### 16 Bag Filling Machines

**BEMIS BROS. BAG CO.**
Richardson Scale Co.
Tamping Bag Co. Div., Pickard Industries Inc.
Thayer Scale

### 17 Bags, Paper, Fabric & Plastic—also see Blasting Bags; Filter Bags

**BEMIS BROS. BAG CO.**
Chase Bag Co.
Daniels, C. R., Inc.
Equitable Paper Bag Co., Inc.
Filtration Engineers Div., American Machine & Metals Inc.
Geophysical Instrument & Supply
Stratex Instrument Co.
Tamping Bag Co. Div., Pickard Industries Inc.

**(Ball Mills—see Mills)**

**(Balls—see Mill Balls)**

### 18 Barges, Floating

**BETHLEHEM STEEL CO.**
**DRAVO CORP.**
Eastern Steel Plate Fabricators, Inc.
Meckum Engineering Inc.
Pacific Coast Engineering Co.
**U. S. STEEL CORP.**

**(Batteries, Storage—see Electric Batteries, Dry and Storage)**

### 19 Bearings, Ball

Aluminum Co. of America
Bitco Inc.
Continental Conveyor & Equipment Co.
Dodge Mfg. Corp.
Fafnir Bearing Co.
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings Inc.
Guyan Machinery Co.
Hoover Ball & Bearing Co.
Kaydon Engineering Corp.
**LINK-BELT CO.**
Marlin-Rockwell Corp.
Metallurgical Products Dept., General Electric Co.
New Departure Div., General Motors Corp.
Nice Ball Bearing Co.
Norma-Hoffman Bearings Corp.
SKF Industries Inc.
Stephens-Adamson Mfg. Co.
Thew Shovel Co.
Torrington Co.

### 20 Bearings, Needle

Bitco Inc.
Kaydon Engineering Corp.
Orange Roller Bearing Co.
Torrington Co.

### 21 Bearings, Plain, Non-Metallic

American Brake Shoe Co.
Continental-Diamond Fibre Corp., Subsidiary Budd Co.
Imperial-Cantrell Mfg. Co.
**JOHNS-MANVILLE**
Ohio Carbon Co.
Taylor Fibre Co.

### 22 Bearings, Plain, Oil-Impregnated & Sintered Metal

Dodge Mfg. Corp.
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings Inc.

### 23 Bearings, Roller

Bitco Inc.
Bower Roller Bearing Div., Federal-Mogul-Bower Bearings Inc.
Chain Belt Co., Shafer Bearing Div.
Continental Conveyor & Equipment Co.
Dodge Mfg. Corp.
Enterprise Wheel & Car Corp.
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings Inc.
General Motors Corp., Hyatt Bearings Div.
Guyan Machinery Co.
Hoover Ball & Bearing Co.
Imperial-Cantrell Mfg. Co.
Kaydon Engineering Corp.
**LINK-BELT CO.**
Marlin-Rockwell Corp.
Norma-Hoffman Bearings Corp.
Orange Roller Bearing Co.
Rollway Bearing Co., Inc.
SKF Industries Inc.
**TIMKEN ROLLER BEARING CO.**
Torrington Co.

### 24 Bearings, Sleeve

American Brake Shoe Co.
American Crucible Products Co.
Dodge Mfg. Corp.
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings Inc.
Flood City Brass & Elec. Co.
**LINK-BELT CO.**
Ohio Carbon Co.
Olds Alloy Co.
Tool Steel Gear & Pinion Co.

### 25 Bearings, Thrust

American Brake Shoe Co.
Bitco Inc.
Chain Belt Co., Shafer Bearing Div.
Dodge Mfg. Corp.
Fafnir Bearing Co.
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings Inc.
Hoover Ball & Bearing Co.
Kaydon Engineering Corp.
**LINK-BELT CO.**
Marlin-Rockwell Corp.
Norma-Hoffman Bearings Corp.
New Departure Div., General Motors Corp.
Nice Ball Bearing Co.
Ohio Carbon Co.
Olds Alloy Co.
Orange Roller Bearing Co.
Rollway Bearing Co., Inc.
SKF Industries Inc.
Saginaw Bearing Co.
**TIMKEN ROLLER BEARING CO.**
Torrington Co.

### 26 Bearing Metal

American Brake Shoe Co.
Ampco Metal Inc.
**CRUCIBLE STEEL CO. OF AMERICA**
Metallurgical Products Dept., General Electric Co.
Olds Alloy Co.
Penn Machine Co.
Saginaw Bearing Co.
**U. S. STEEL CORP.**

### 27 Bearing Pillow Blocks, Hangers & Journal Boxes

Bitco Inc.
Browning Mfg. Co.
**CARD, C. S., IRON WORKS**
Chain Belt Co.
Chain Belt Co., Shafer Bearing Div.
Continental Conveyor & Equipment Co.
Dodge Mfg. Corp.
Fafnir Bearing Co.
**GATES RUBBER CO.**
General Motors Corp., Hyatt Bearings Div.
Guyan Machinery Co.
**HEWITT-ROBINS INC.**
Hoover Ball & Bearing Co.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Lovejoy Flexible Coupling Co.
Marlin-Rockwell Corp.
**McNALLY PITTSBURGH MFG. CORP.**
New Departure Div., General Motors Corp.
Nice Ball Bearing Co.
Pickard Industries Inc., Central Mine Supply Co. Div.
SKF Industries Inc.
Stephens-Adamson Mfg. Co.
**TIMKEN ROLLER BEARING CO.**
Torrington Co.

**(Belt Fasteners—see Fasteners, Belt)**

**(Belt, Conveyor—see Conveyor Belting)**

### 28 Belts, Flat Power Transmission

**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
American Rubber Mfg. Co.
Bitco Inc.
Cincinnati Rubber Mfg. Co. Div., Thor Power Tool Co.
Extremultus Inc.
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**GOODYEAR TIRE & RUBBER CO.**
**HEWITT-ROBINS INC.**
Manheim Mfg. & Belting Co.
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.**
Republic Rubber Div., Lee Rubber & Tire Corp.
Rhoads, J. E., & Son
Russell Mfg.
Thermoid Div., H. K. Porter Co., Inc.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**

### 29 Belts, "V"

**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
American Pulley Co.
Bitco Inc.
Browning Mfg. Co.
Dodge Mfg. Corp.
**FLEXIBLE STEEL LACING CO.**
Flood City Brass & Elec. Co.
**GATES RUBBER CO.**
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**GOODYEAR TIRE & RUBBER CO.**

Guyan Machinery Co.
Lovejoy Flexible Coupling Co.
Manheim Mfg. & Belting Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.**
Republic Rubber Div., Lee Rubber & Tire Corp.
Thermoid Div., H. K. Porter Co., Inc.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**

### 30 Belt Dressing

**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
Rhoads, J. E., & Son

### 31 Bin & Chute Gates and Mechanisms — *also see* Feeders

Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, J. D., Engineers
Coeur D'Alenes Co.
Columbus Conveyor Co.
Denver Equipment Co.
Erie Strayer Co.
Fairmont Machinery Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
**NATIONAL IRON CO.**
Ogden Iron Works Co.
Pulva Corp.
Rockiron Co., Ltd.
Standard Metal Mfg. Co.
Stephens-Adamson Mfg. Co.
**TREADWELL, M. H., CO., INC.**
**U. S. STEEL CORP.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**

### 32 Bins & Hoppers, Bulk Solids Storage — for liquids, see Tanks

Arrow Tank Co.
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
**BETHLEHEM STEEL CO.**
Blaw-Knox Co.
Bodinson Mfg. Co., Inc.
Butler Mfg. Co.
**CARD, C. S., IRON WORKS**
Chicago Bridge & Iron Co.
Denver Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Eastern Steel Plate Fabricators Inc.
Engineered Equipment Inc.
Enterprise Wheel & Car Corp.
Erie Strayer Co.
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
Industrial Engineering & Construction Co.
**IOWA MFG. CO.**
Irwin Sensenich Corp.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Marietta Concrete Div., American-Marietta Co.
**McNALLY PITTSBURG MFG. CORP.**
Meckum Engineering Inc.
**NATIONAL IRON CO.**
Ogden Iron Works Co.
Parkersburg Rig & Reel Co.
Richardson Scale Co.
Ridge Equipment Co.
Rockiron Co., Ltd.
Santa Fe Tank Div., Fluor Products Co.
Simmons Boiler & Machine Co.
Standard Metal Mfg. Co.
Stephens-Adamson Mfg. Co.
**TREADWELL, M. H., CO., INC.**
**U. S. STEEL CORP.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Universal Road Machinery Co.
**WESTERN CONVEYOR CO.**

### 33 Bins & Tank-Level Indicators—also see Meters & Gages

B-I-F Industries Inc.
Bin-Dicator Co.
Convair Inc.
Erie Strayer Co.
Fuller Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HEWITT-ROBINS INC.**
Industrial Nucleonics Corp.
Jeffrey Mfg. Co.
OPW-Jordan Corp.
Richardson Scale Co.
Roberts & Schaefer Co., Div. Thompson-Starrett Co., Inc.
Stephens-Adamson Mfg. Co.
**U. S. STEEL CORP.**

### (Bits—see Drill (Rock) Bits)

### 34 Blast Cleaning Equipment

Exolon Co.
Midwestern Engine & Equipment Co.
Norton Co.
Wheelabrator Corp.

### 35 Blasting Accessories & Equipment

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
Coast Mfg. & Supply Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**ENSIGN-BICKFORD CO.**
Hammond, J. V., Co.
**HERCULES POWDER CO.**
Mayhew Machine & Supply Co.
**MINE SAFETY APPLIANCES CO.**
National Powder Co.
Remington Arms Co., Inc.
Salem Tool Co.
Trojan Powder Co.
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**

### 36 Blasting Agent Primers

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
Coast Mfg. & Supply Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 37 Blasting Bags, Powder & Tamping

**AMERICAN BRATTICE CLOTH CORP.**
**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
**BEMIS BROS. BAG CO.**
Canadian Industries Ltd.
Chase Bag Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
National Powder Co.
Salem Tool Co.
Tamping Bag Co., Div. Pickard Industries Inc.
Trojan Powder Co.

### 38 Blasting Compound Chargers, Pneumatic

Air Placement Equipment Co.
**ATLAS POWDER CO.**

### 39 Blasting Compound Loading & Retrieving Hooks

Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
Trojan Powder Co.

### 40 Blasting Compounds, Ammonium Nitrate and other uncompounded agents

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Spencer Chemical Co.
Trojan Powder Co.

### 41 Blasting Compounds, black powder

Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
National Powder Co.

### 42 Blasting Compounds, blasting agents (compounded)

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 43 Blasting Compounds, high explosive, dynamite, nitroglycerin base

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 44 Blasting Compounds, high explosive, non nitroglycerin and military types

**ATLAS POWDER CO.**
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 45 Blasting Detonating Cap Crimpers (Hand)

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
Coast Mfg. & Supply Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 46 Blasting Detonating Caps, Boosters & Connectors

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 47 Blasting Fuse Lighters

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
Coast Mfg. & Supply Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Fuse & Powder Co.
National Powder Co.
Trojan Powder Co.

### 48 Blasting Fuses, Safety Detonating, et al

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
Coast Mfg. & Supply Co.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**ENSIGN-BICKFORD CO.**
**HERCULES POWDER CO.**

National Fuse & Powder Co.
National Powder Co.
Trojan Powder Co.

### 49 Blasting Galvanometers

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Special Instruments Laboratory Inc.
Trojan Powder Co.

### 50 Blasting Machines, Electric, Battery Condenser Discharge

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
**MINE SAFETY APPLIANCES CO.**
National Powder Co.
Trojan Powder Co.

### 51 Blasting Machines, Electric, Hand Push Generator

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Trojan Powder Co.

### 52 Blasting Seismometers

Southwestern Industrial Electronics Co.
Sprengnether W. F., Instrument Co., Inc.
Trojan Powder Co.

### 54 Blasting Stemming Plugs (Tamping Plugs)

Air Placement Equipment Co.
**NATIONAL MINE SERVICE CO.**
Trojan Powder Co.

### 55 Blasting Switches, Electric Power

**ATLAS POWDER CO.**
Canadian Industries Ltd.
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**

### 56 Blasting Tamping Sticks, Sectional

Apache Powder Co.
**ATLAS POWDER CO.**
Hammond, J. V., Co.
Johnson Loading Supplies
National Powder Co.
Tamping Bag Co., Div. Pickard Industries Inc.
Trojan Powder Co.

### 57 Blasting Wire (Leading & Connecting)

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
Apache Powder Co.
**ATLAS POWDER CO.**
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
**HERCULES POWDER CO.**
National Powder Co.
Rome Cable Corp., Rome Cable Division of Alcoa
Trojan Powder Co.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 58 Blasting (Leg) Wire Connectors

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
**ATLAS POWDER CO.**
**DuPONT de NEMOURS & CO., INC., EXPLOSIVES DEPT.**
National Powder Co.
Trojan Powder Co.

### (Blenders—see Agitators)

### 59 Blocks, Pulleys & Sheaves — also see Sheaves, Mine Hoist

**AMERICAN HOIST & DERRICK CO.**
American Pulley Co.
Bonded Scale & Machine Co.
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
Dodge Mfg. Corp.
Guyan Machinery Co.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
Lake Shore Inc., Lake Shore Engineering Div.
Pickard Industries Inc., Central Mine Supply Co., Div.
Rope Master, Keeney, Paul E., Co.
**SAUERMAN BROS. INC.**
**VAN GORP MFG. INC.**
**VULCAN IRON WORKS CO.**
Washington Iron Works

### (Blowers—see Fans; Concrete Sprayers; Refractory Placers)

### 60 Blue, Photo & White Print Machines

Paragon-Revolute, Charles Bruning Co., Inc.
Peerless Photo Products Inc.
Frederick Post Co.

### 61 Boilers & Heaters, Liquid —does not include Heaters, Space; Retorts

American Standard Industrial Div.
Ames Iron Works, Inc.
**BABCOCK & WILCOX CO.**
Combustion Engineering Inc.
Cutler-Hammer Inc.
Keeler, E., Co.
Rockiron Co., Ltd.
Southwestern Engineering Co.
Vogt, Henry, Machine Co.

### (Bolts—see Fasteners; Rock Bolts)

### (Booms, Loading—see Cranes; Conveyors)

### 62 Booms & Towers, Extensible & Motile, Mobile & Stationary—does not include Drill (Rock) Booms; Drill (Rock) Jumbos; Booms, Loading

Austin-Western, Construction Equipment Div.
Industrial Engineering & Construction Co.
Mobile Aerial Towers Inc.
Southwestern Industrial Electronics Co.
Washington Iron Works

### 63 Brakes, Dynamic—also see Brakes, Magnetic

Parkersburg Rig & Reel Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 64 Brakes, Friction Disk & Block

American Brake Shoe Co.
American Chain & Cable Co., Automotive & Aircraft Div.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Cutler-Hammer Inc.
**GOODRICH, B. F., AVIATION PRODUCTS**
Guyan Machinery Co.
**JOHNS-MANVILLE**
Kersey Mfg. Co., Inc.
Penn Machine Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
Thermoid Div., H. K. Porter Co., Inc.
Wagner Electric Corp.

### 65 Brakes, Magnetic

Allis, Louis, Co.
**CLARK CONTROLLER CO.**
Cutler-Hammer Inc.
General Electric Co., Apparatus Sales Div.
Hillman, C. Kirk, Co., Inc.
Metallurgical Products Dept., General Electric Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 66 Brattice Cloth

**AMERICAN BRATTICE CLOTH CORP.**
Daniels, C. R., Inc.
Flocker, John & Co.
Johnston-Morehouse-Dickey Co.

### 67 Briquetting Equipment — does not include Nodulizing, Pelletizing Balling or Sintering Equipment

Kloeckner-Humboldt-Deutz AG

### 68 Buckets, Bucketline Dredge

American Brake Shoe Co.
Erie Strayer Co.
McDowell Co., Inc., Wellman Engineering Co.
Pettibone Mulliken Corp.
Taylor Wharton Div., Harsco Corp.

### 69 Buckets, Clamshell & Grab

Blaw-Knox Co.
Bucyrus-Erie Co.
Coeur D'Alenes Co.
**ELECTRIC STEEL FOUNDRY CO.**
Erie Strayer Co.
**HARNISCHFEGER CORP.**
McDowell Co., Inc., Wellman Engineering Co.
Owen Bucket Co.
Pettibone Mulliken Corp.
Schield Bantam Co.
Yaun Mfg. Co., Inc.

### 70 Buckets, Conveyor & Elevator—does not include Buckets, Tramway & Trolley

American Brake Shoe Co.
B-I-F Industries Inc.
Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, D. D., Engineers
Columbus Conveyor Co.
Continental Conveyor & Equipment Co.
Enterprise Wheel & Car Corp.
Erie Strayer Co.
Fairmont Machinery co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
Jeffrey Mfg. Co.
Laubenstein Mfg. Co.
**LINK-BELT CO.**
**McNALLY PITTSBURG MFG. CORP.**
Northern Conveyor Co.
Ogden Iron Works Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
Smith Engineering Works
Standard Metal Mfg. Co.
Stephens-Adamson Mfg. Co.
Taylor Wharton Div., Harsco Corp.
**U. S. STEEL CORP.**
Universal Road Machinery Co.
Watt Car & Wheel Co.

### 71 Buckets, Dipper Shovel

American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Bucyrus-Erie Co.
**ELECTRIC STEEL FOUNDRY CO.**
Pettibone Mulliken Corp.
Quick-Way Truck Shovel Co.
Schield Bantam Co.
Sorel Steel Foundries Ltd.
Taylor Wharton Div., Harsco Corp.

### 72 Buckets, Dragline Crane

Blaw-Knox Co.
Bucyrus-Erie Co.
**ELECTRIC STEEL FOUNDRY CO.**
Erie Strayer Co.
**HARNISCHFEGER CORP.**
Hendrix Mfg. Co.

McDowell Co., Inc., Wellman Engineering Co.
Page Engineering Co.
Pettibone Mulliken Corp.
Quick-Way Truck Shovel Co.
Schield Bantam Co.
Sorel Steel Foundries Ltd.
Yaun Mfg. Co., Inc.

### 73 Buckets, Dragline Scraper-Slusher

American Brake Shoe Co.
**ELECTRIC STEEL FOUNDRY CO.**
**JOY MFG. CO.**
**MACHINERY CENTER INC.**
McDowell Co., Inc., Wellman Engineering Co.
Page Engineering Co.
**SAUERMAN BROS. INC.**
Sorel Steel Foundries Ltd.
Taylor Wharton Div., Harsco Corp.
**VULCAN IRON WORKS CO.**
Yaun Mfg. Co., Inc.

### 74 Buckets, Hoisting & Sinking—does not include Skips & Cages

**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
Erie Strayer Co.
Lake Shore Inc., Lake Shore Engineering Div.
Lidgerwood Mfg. Co.
**MACHINERY CENTER INC.**
**MAYO TUNNEL & MINE EQUIPMENT**
**VULCAN IRON WORKS CO.**

### 75 Buckets, Tramway & Trolley

Lidgerwood Mfg. Co.
**RIBLET TRAMWAY CO.**

### 76 Bucket Teeth & Wear-Replacement Parts

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
American Steel Foundries
Blaw-Knox Co.
**ELECTRIC STEEL FOUNDRY CO.**
Erie Strayer Co.
Hendrix Mfg. Co.
Ladish Co.
Manganese Steel Forge Co.
McDowell Co., Inc., Wellman Engineering Co.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Pettibone Mulliken Corp.
Quick-Way Truck Shovel Co.
**SAUERMAN BROS. INC.**
Schield Bantam Co.
Sorel Steel Foundries Ltd.
Stroh Process Steel Co.
Taylor Wharton Div., Harsco Corp.

### 77 Buildings, Prefab

Armco Drainage & Metal Products
Arrowhead Steel Buildings Inc.
Butler Mfg. Co.
**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV.**
Dresser-Ideco Co.
Parkersburg Rig & Reel Co.

**(Bulldozers & Angle Dozer Blades—see Tractor Attachments)**

### 78 Burners, Oil, Gas & Coal (for Heaters, Furnaces, Kilns, etc.)

**BABCOCK & WILCOX CO.**
Campbell, E. K., Co.
**COPPUS ENGINEERING CO.**
Denver Fire Clay Co.
Enterprise Engine & Machinery Co.
Hauck Mfg. Co., Equipment Div.
Kloeckner-Humboldt-Deutz AG
Rockiron Co., Ltd.
Rockwell, W. S., Co.
Southwestern Engineering Co.
Surface Combustion Div., Midland-Ross Corp.
**UTAH HYDRO CORP.**

### 79 Burners, Hand Torch & Mobile (for Thawing, Weed Burning, etc.)—also see Car Thawers; does not include Welding & Cutting Equipment

Hauck Mfg. Co., Equipment Div.
**UTAH HYDRO CORP.**

## C

**(Cable—see Electrical Cable; Wire Rope)**

**(Cableways—see Aerial Tramways)**

**(Cages, Mine Hoist — see (Skips & Cages)**

**(Calculators—see Computing Machines; Drafting Equip.; Meters; Office Machines)**

### 80 Cap Lamp Carbide

Geophysical Instrument & Supply

### 81 Cap Lamps, Carbide

Geophysical Instrument & Supply

### 82 Cap Lamps, Electric

**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**

**(Car Accessories, Mine & Commercial R.R.—see below; also see Track . . .; Rail . . .)**

### 83 Car (R.R.) Bodies

ACF Industries Inc., American Car & Foundry Div.
**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
Enterprise Wheel & Car Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**MAGOR CAR CORP.**
Rail & Industrial Equipment Co., Inc.

### 84 Car Cagers & Spotters—does not include Car Movers

**CARD, C. S., IRON WORKS**
**CONNELLSVILLE MFG. & MINE SUPPLY**
Flood City Brass & Elec. Co.
**LINK-BELT CO.**
Nolan Co.
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.
Sanford-Day Iron Works Inc.

### 85 Car (R.R.) Couplers & Draft Gear

**CARD, C. S., IRON WORKS**
Enterprise Wheel & Car Corp.
**MAYO TUNNEL & MINE EQUIPMENT**
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
**OHIO BRASS CO.**
Rail & Industrial Equipment Co., Inc.

### 86 Car (R.R.) Derailers & Rerailers & Chocks — does not include switch-type derailers; see Rail Switches

**AMERICAN MINE DOOR CO.**
**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
Nolan Co.
Pettibone Mulliken Corp.
Sanford-Day Iron Works Inc.
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 87 Car (& Truck) Dumping Devices

**CARD, C. S., IRON WORKS**
**DIFFERENTIAL STEEL CAR CO.**
Frank, M. K.
Galion Allsteel Body Co.
Heil Co.—TEC Division
Hercules Steel Products Co.
**LINK-BELT CO.**
**MAGOR CAR CORP.**
**MARION METAL PRODUCTS CO.**
McDowell Co., Inc., Wellman Engineering Co.
OPW-Jordan Corp.
Pacific Coast Engineering Co.
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.
Rockiron Co., Ltd.
**TREADWELL, M. H., CO., INC.**

### 88 Car (R.R.) Movers, Hand

Foster, L. B., Co.
Frank, M. K.
Irwin Sensenich Corp.
Rail & Industrial Equipment Co., Inc.

### 89 Car (R.R.) Movers, Special Tractor Type

**ATLAS CAR & MFG. CO.**
Foster, L. B., Co.
Frank, M. K.
Hough, Frank G., Co.
Oshkosh Motor Truck Inc.
Whiting Corp.

### 90 Car (R.R.) Movers Winch Type

Foster, L. B., Co.
Frank, M. K.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
**Joy Mfg. Co.**
**LINK-BELT CO.**
Sanford-Day Iron Works Inc.
Shepard Niles Crane & Hoist Corp.
Stephens-Adamson Mfg. Co.
Superior-Lidgerwood-Mundy Corp.
Washington Iron Works

### 91 Car (R.R.) Retarders

American Brake Shoe Co.
Fairmont Machinery Co.
Foster, L. B., Co.
Frank, M. K.
**HEWITT-ROBINS INC.**
**LINK-BELT CO.**
**McNALLY PITTSBURG MFG. CORP.**
Sanford-Day Iron Works Inc.
Union Switch & Signal, Westinghouse Air Brake Co.

### 92 Car & Motor Truck Shakers

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**HEWITT-ROBINS INC.**
**LINK-BELT CO.**
Martin Engineering Co.

### 93 Car (R.R.) Transfers, Passers, Etc.

**AMERICAN MINE DOOR CO.**
**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Irwin Sensenich Corp.
**MAYO TUNNEL & MINE EQUIPMENT**
McDowell Co., Inc., Wellman Engineering Co.
Rail & Industrial Equipment Co., Inc.

### 94 Car (R.R.) Trucks—also see Car Wheels

ACF Industries Inc., American Car & Foundry Div.
**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
**DIFFERENTIAL STEEL CAR CO.**
Enterprise Wheel & Car Corp.
IRWIN SENSENICH CORP.
**MAGOR CAR CORP.**
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Rockiron Co., Ltd.
Sanford-Day Iron Works Inc.

### 95 Car (R.R.) Turntables

**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
**HARDINGE CO., INC.**
Whiting Corp.

### 96 Car (& Truck) Thawers

Hauck Mfg. Co., Equipment Div.
**HEWITT-ROBINS INC.**

### 97 Car (& Locomotive) Wheels & Axles

Alco Products, Inc.
American Brake Shoe Co.
**ATLAS CAR & MFG. CO.**
**BALDWIN-LIMA-HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV.**
**BALDWIN-LIMA-HAMILTON CORP., STANDARD STEEL WORKS DIV.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
**DIFFERENTIAL STEEL CAR CO.**
Enterprise Wheel & Car Corp.
Frank, M. K.
Ironton Engine Co.
Irwin Sensenich Corp.
Kersey Mfg. Co., Inc.
**MAGOR CAR CORP.**
**MAYO TUNNEL & MINE EQUIPMENT**
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Penn Machine Co.
Sanford-Day Iron Works Inc.
Tool Steel Gear & Pinion Co.
**U. S. STEEL CORP.**
Watt Car & Wheel Co.

### 98 Car Wheel & Gear Pullers

Armstrong, Bray & Co.
Irwin Sensenich Corp.
Owatonna Tool Co.

### 99 Carbides, Tungsten & Other Hard Metals (Sintered, Cemented, etc.)

Adamas Carbide Corp.
Allegheny Ludlum Steel Corp.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Engelhard Industries Inc.
Exolon Co.
Firth Sterling Inc.
Haynes Stellite Co., Div., Union Carbide Corp.
Kennametal Inc., Mining Tool Div.
Long-Airdox Co., Marmon-Herrington Inc.
Metal Carbides Corp.
Rexarc Inc., Sight Feed Generator Co.
Sandvik Steel Inc.
Vascoloy-Ramet Corp.

### 100 Cars, Commercial Railroad

ACF Industries Inc., American Car & Foundry Div.
**BETHLEHEM STEEL CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**MAGOR CAR CORP.**
Rail & Industrial Equipment Co., Inc.

### 101 Cars, Mine R.R.—*also see specific types below*

ACF Industries Inc., American Car & Foundry Div.
**BALDWIN-LIMA-HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
Denver Equipment Co.
**DIFFERENTIAL STEEL CAR CO.**
Enterprise Wheel & Car Corp.
Foster, L. B., Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Irwin Sensenich Corp.
Kersey Mfg. Co., Inc.
**MAGOR CAR CORP.**
**MAYO TUNNEL & MINE EQUIPMENT**
**MORSE BROS. MACHINERY CO.**
Rockiron Co., Ltd.
Sanford-Day Iron Works Inc.
**U. S. STEEL CORP.**
Watt Car & Wheel Co.

### 102 Cars, Mine & Industrial R.R., Man & Special types

ACF Industries Inc., American Car & Foundry Div.
**ATLAS CAR & MFG. CO.**
**BALDWIN-LIMA-HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
**DIFFERENTIAL STEEL CAR CO.**
Enterprise Wheel & Car Corp.
Foster, L. B., Co.
Frank, M. K.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Irwin Sensenich Corp.
Kersey Mfg. Co., Inc.
Lake Shore Inc., Lake Shore Engineering Div.
**MAGAR CAR CORP.**
**MAYO TUNNEL & MINE EQUIPMENT**
**NATIONAL MINE SERVICE CO.**
Rail & Industrial Equipment Co., Inc.
Rockiron Co., Ltd.
Sanford-Day Iron Works Inc.
**U. S. STEEL CORP.**
Watt Car & Wheel Co.

### 103 Cars, Mine R.R. Automatic Dump

**BALDWIN-LIMA-HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
**DIFFERENTIAL STEEL CAR CO.**
Enterprise Wheel & Car Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Lake Shore Inc., Lake Shore Engineering Div.
**MAGOR CAR CORP.**
**MAYO TUNNEL & MINE EQUIPMENT**
Ogden Iron Works Co.
Rockiron Co., Ltd.
Sanford-Day Iron Works Inc.
**TREADWELL, M. H., CO., INC.**
Watt Car & Wheel Co.

### 104 Cars, Mine R.R., Fire—*also see* Fire Fighting Equipment

Watt Car & Wheel Co.

### 105 Cars, Mine R.R., Hand Dump

ACF Industries Inc., American Car & Foundry Div.
**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
Denver Equipment Co.
Enterprise Wheel & Car Corp.
Frank, M. K.
Lake Shore Inc., Lake Shore Engineering Div.
**MAGOR CAR CORP.**
**MAYO TUNNEL & MINE EQUIPMENT**
Ogden Iron Works Co.
Sanford-Day Iron Works Inc.
**TREADWELL, M. H., CO., INC.**
Watt Car & Wheel Co.

### 106 Cars, Mine R.R. Self-Loading

**(Cars, Shuttle — *see* Trucks)**

**CARD, C. S., IRON WORKS**
Filtration Engineers Div., American Machine & Metals Inc.

### 107 Casting Wheels, Smelter

Dominion Engineering Co., Ltd.
Irwin Sensenich Corp.
**STEARNS ROGER MFG. CO.**
Tool Steel Gear & Pinion Co.
**TRAYLOR ENGRG. & MFG. CO.**
**TREADWELL, M. H., CO., INC.**

### 108 Castings, Iron (Gray, Malleable etc.)

ACF Industries Inc., American Car & Foundry Div.
American Brake Shoe Co.
American Cast Iron Pipe Co.
**BETHLEHEM STEEL CO.**
Cadillac Malleable Iron Co.
Calumet Div., Calumet & Hecla, Inc.
**CARD, C. S., Iron Works**
Carondelet Foundry Co.
Chain Belt Co.
Crossley Machine Co.
Davis Foundry & Machine Works
Enterprise Wheel & Car Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HARDINGE CO., INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
Kansas City Hay Press
Lake Shore Inc., Lake Shore Engineering Div.
**LINK-BELT CO.**
Lombard Governor Corp.
**McLANAHAN & STONE CORP.**
**McNALLY PITTSBURG MFG. CORP.**
Meehanite Corp.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
**NORDBERG MFG. CO.**
Rogers Iron Works Co.
Sheppard, R. H., & Co., Inc.
**STEARNS ROGER MFG. CO.**
**VULCAN IRON WORKS Co.**

### 109 Castings, Ferrous Alloys

American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
American Cast Iron Pipe Co.
Atlas Steel Casting Co.
**BABCOCK & WILCOX CO.**
**BETHLEHEM STEEL CO.**
Calumet Div., Calumet & Hecla Inc.
Carondelet Foundry Co.
Dixon Valve & Coupling Co.
**ELECTRIC STEEL FOUNDRY CO.**
Empire Steel Castings Inc.
Enterprise Wheel & Car Corp.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Lebanon Steel Foundry
Lombard Governor Corp.
Meehanite Corp.
Metal Goods Corp.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Rogers Iron Works Co.
**STEARNS ROGER MFG. CO.**
Stroh Process Steel Co.
Taylor Wharton Div., Harsco Corp.
Thomas Foundries Inc.
**VULCAN IRON WORKS CO.**

### 110 Castings, Nonferrous

American Crucible Products Co.
Ampco Metal Inc.
**BALDWIN-LIMA-HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV.**
Belmont Smelting & Refining Works
**BETHLEHEM STEEL CO.**
Dixon Valve & Coupling Co.
Enterprise Wheel & Car Corp.
Flood City Brass & Elec. Co.
Haynes Stellite Co., Div., Union Carbide Corp.
**INTERNATIONAL NICKEL CO.**
Lombard Governor Corp.
Metal Goods Corp.
Olds Alloy Co.
Penn Machine Co.
Saginaw Bearing Co.
**STOODY CO.**

### 111 Castings, Steel

American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANENSE STEEL DIV.**
American Cast Iron Pipe Co.
Atlas Steel Casting Co.
American Steel Foundries
**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
**BETHLEHEM STEEL CO.**
**BIRDSBORO CORP.**
Blaw-Knox Co.
**CARD, C. S., IRON WORKS**
Carondelet Foundry Co.
Duriron Co., Inc.
**ELECTRIC STEEL FOUNDRY CO.**
Empire Steel Castings Inc.
**FALK CORP.**
Frog, Switch & Mfg. Co.
Lebanon Steel Foundry
Lombard Governor Corp.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Pettibone Mulliken Corp.
Rogers Iron Works Co.
Sorel Steel Foundries Ltd.
Stroh Process Steel Co.
Taylor Wharton Div., Harsco Corp.
Thomas Foundries Inc.
Tool Steel Gear & Pinion Co.
Washington Iron Works

### 112 Chain, Cast & Welded

America Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MAGANESE STEEL DIV.**
American Chain Div., American Chain & Cable Co., Inc.
Ampco Metal Inc.
Bitco Inc.
Chain Belt Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
**ELECTRIC STEEL FOUNDRY CO.**
Flocker, John & Co.
Long-Airdox Co., Marmon-Herrington Inc.
McKay Co.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Olds Alloy Co.
Pickard Industries Inc., Central Mine Supply Co., Div.

### 113 Chain, Power Transmission

American Brake Shoe Co.

Atlas Chain & Mfg. Co.
Bitco Inc.
Browning Mfg. Co.
Chain Belt Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Diamond Chain Co., Inc.
Dodge Mfg. Corp.
Guyan Machinery Co.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
**McNALLY PITTSBURG MFG. CORP.**
Morse Chain Co., Borg-Warner Industry
Penn Machine Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
Union Chain & Mfg. Co.

### 114 Chain Fittings & Accessories

American Chain Div., American Chain & Cable Co., Inc.
**AMERICAN HOIST & DERRICK CO.**
Bitco, Inc.
Chain Belt Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Dodge Mfg. Corp.
Flocker, John & Co.
Interstate Drop Forge Co., Special Products Division
Jeffrey Mfg. Co.
**LINK-BELT CO.**
McKay Co.
Morse Chain Co., Borg-Warner Industry
Pickard Industries Inc., Central Mine Supply Co. Div.
Sorel Steel Foundries Ltd.
Union Chain & Mfg. Co.

### 115 Chain Slings

American Chain Div., American Chain & Cable Co., Inc.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Flocker, John, & Co.
Guyan Machinery Co.
**LINK-BELT CO.**
McKay Co.
Owatonna Tool Co.
Pickard Industries Inc., Central Mine Supply Co. Div.

**(Chain Sprockets—*see* Gears)**

### 117 Chemical Laboratory Equipment & Supplies—does not include Chemicals, *also see* Meters, Laboratory & Scientific Instruments other than . . . etc.

Bico Inc.
Bristol Co.
Cahn Instrument Corp.
Corning Glass Works
Fisher Scientific Co.
Geophysical Instrument & Supply
Jarrell-Ash Co.
Laboratory Equipment Corp.
**MINE & SMELTER SUPPLY CO.**
Philips Electronic Instruments
Precision Thermometer & Instrument Co.
Sharples Corp.
Southwestern Engineering Co.
U. S. Stoneware Co.

### 118 Chemicals — *also see* Flotation Reagents; Water treatment Chemicals

Allied Chemical Corp., Solvay Process Div.
**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
**AMERICAN POTASH & CHEMICAL CO.**
Ansul Chemical Co.
Apache Powder Co.
**ARMOUR INDUSTRIAL CHEMICAL CO.**
**BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP.**
Baker Chemical Co.
Dow Chemical Co.
Dow Corning Corp.
Fisher Scientific Co.
Food Machinery & Chemical Corp., Mineral Products Div., Chlor-Alkali Div.
Freeport Sulphur Co.
Hagan Chemicals & Controls Inc., Calgon Co., Hall Laboratories
**HERCULES POWDER CO.**
Marathon Div., American Can Co.
Minnesota Mining & Mfg. Co.
Nalco Chemical Co.
Onyx Chemical Corp.
Pacific Lumber Co.
Pennsalt Chemicals Corp.
**PHILADELPHIA QUARTZ CO.**
Reilly Tar & Chemical Corp.
Stein, Hall & Co., Inc.
Tennessee Corp.
Texas Gulf Sulphur Co.
**U. S. STEEL CORP.**

**(Classifiers—*see* below; *also see* Dust Collectors & Precipitators; Filters; Separators; Screens; Scrubbers; Thickeners)**

### 119 Classifiers, Cyclone Dry

**BUELL ENGINEERING CO.**
Combustion Engineering Inc.
**KELLOGG, M. W., CO., DIV., PULLMAN INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.
Sharples Corp.
**STURTEVANT MILL CO.**
**WESTERN PRECIPITATION DIV., JOY MFG. CO.**

### 120 Classifiers, Cyclone, Wet

Dagley Mfg. Co.
Denver Equipment Co.
**DORR OLIVER INC.**
**EQUIPMENT ENGINEERS INC.**
Fairmont Machinery Co.
**GEORGIA IRON WORKS CO.**
Meckum Engineering Inc.
**PETERSON FILTERS & ENGINEERING CO.**
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.

### 121 Classifiers, Dry, Hindered Settling

Bico Inc.

### 122 Classifiers, Dry Setting

**McNALLY PITTSBURGH MFG. CORP.**

### 123 Classifiers, Mechanical, Dry, Centrifugal Impeller

Combustion Engineering Inc.
**HARDINGE CO., INC.**
Majac, Inc.
Sharples Corp.
**STURTEVANT MILL CO.**
Universal Road Machinery Co.

### 125 Classifiers, Mechanical, Wet, Belt (Cleated & Plain)

Denver Equipment Co.
Hack Engineering Co.
**LINK-BELT CO.**
Rogers Iron Works Co.
Universal Dredge Mfg. Co.

### 126 Classifiers, Mechanical, Wet, Centrifuge

Bird Machine Co.
**DORR OLIVER INC.**
Kloeckner-Humboldt-Deutz AG
Sharples Corp.
Smith Engineering Works
**WESTERN MACHINERY CO., WEMCO DIV.**

### 127 Classifiers, Mechanical, Wet, Centrifugal Impeller

Sharples Corp.

### 128 Classifiers, Mechanical, Wet, Rake, Bowl

**DORR OLIVER INC.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MORSE BROS. MACHINERY CO.**

### 129 Classifiers, Mechanical, Wet, Rake, Multi-Drag-Scraper

Denver Equipment Co.
**LINK-BELT CO.**

### 130 Classifiers, Mechanical, Wet, Rake, Reciprocating Hoe

**DORR OLIVER INC.**
**HARDINGE CO., INC.**
**LINK-BELT CO.**

### 131 Classifiers, Mechanical, Wet, Rake, Ultra-Sonic

**LINK-BELT CO.**

### 132 Classifiers, Spiral-Screw

Christian, J. D., Engineers
Denver Equipment Co.
Eagle Iron Works
Hack Engineering Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**McLANAHAN & STONE CORP.**
**MINE & SMELTER SUPPLY CO.**
Rogers Iron Works Co.
Sharples Corp.
**STRAUBE MFG. CO.**
Universal Dredge Mfg. Co.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 133 Classifiers, Wet Hindered Settling

**DEISTER CONCENTRATOR CO.**
**DEISTER MACHINE CO.**
Denver Equipment Co.
**DORR OLIVER INC.**
**HARDINGE CO., INC.**
Roberts & Schaefer Co., Div. Thompson-Starrett Co., Inc.
**WESTERN MACHINERY CO. WEMCO DIV.**

### 134 Classifiers, Wet, Settling, Bowl or Tank

**DORR OLIVER INC.**
Eagle Iron Works
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Meckum Engineering Inc.
Roberts & Schaefer Co., Div. Thompson-Starrett Co., Inc.
Rogers Iron Works Co.
Smith Engineering Works

**(Classifiers, Wet, Sluicing — *see* Separators, Sluice)**

### 135 Cloth & Fabrics—*also see* Bags; Brattice Cloth; Filter Cloth; Insulation Cloth; Tarpaulins; Ventilation Tubing; Wire Cloth

Albany Felt Co.
**AMERICAN BRATTICE CLOTH CORP.**
**BEMIS BROS. BAG CO.**
Chase Brass & Copper Co.
Daniels, C. R., Inc.
**EIMCO CORP.**
Filtration Engineers Div., American Machine & Metals Inc.
Flocker, John, & Co.
Hoyt Wire Cloth Co.
Minnesota Mining & Mfg. Co.
Multi-Metal Wire Cloth Co., Inc.
Pendleton Woolen Mills
Pickard Industries Inc., Central Mine Supply Co. Div.
Southwestern Engineering Co.
Star Wire Screen & Iron Works Inc.
**TYLER, W. S., CO.**
Wellington Sears Co.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

**(Clothing—*see* Safety Clothing)**

**(Clutches, Fluid—*see* Drives, Fluid)**

### 136 Clutches, Friction

American Brake Shoe Co.
Bitco Inc.

Central Mine Equipment Co.
Cutler-Hammer Inc.
Dodge Mfg. Corp.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Lombard Governor Corp.
Morse Chain Co., Borg-Warner Industry
Penn Machine Co.
Thermoid Div., H. K. Porter Co., Inc.
Tool Steel Gear & Pinion Co.
Twin Disc Clutch Co.

**(Clutches, Magnetic — *see* Drives, Magnetic)**

### 137 Coatings, Abrasion-Resistant, Non-Metallic—does not include Linings & Claddings

Amercoat Corp.
Carboline Co.
Eagle-Picher Co.
Galigher Co.
Haynes Stellite Co., Div., Union Carbide Corp.
**LINATEX CORP. OF AMERICA**
Reilly Tar & Chemical Corp.
Sherwin-Williams Co.
Sika Chemical Corp.

### 138 Coatings, Chemical & Corrosion-Resistant, Metallic—*also see* Metalizing; does not include Linings & Claddings

Amercoat Corp.
**AMERICAN SMELTING & REFINING CO. FEDERATED METALS DIV.**
Carboline Co.
Carbolineum Wood Preserving Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Gulf Oil Corp.
Haynes Stellite Co., Div. Union Carbide Corp.
Keystone Lubricating Co.
Solar Aircraft Co.
U. S. Stoneware Co.

### 139 Coatings, Chemical & Corrosion - Resistant, Non-Metallic—does not include Linings & Claddings; Paints

Allied Chemical Corp., Solvay Process Div.
Amercoat Corp.
**ARMOUR INDUSTRIAL CHEMICAL CO.**
Atlantic Refining Co.
Carboline Co.
**COORS PORCELAIN CO.**
Denver Equipment Co.
Dow Corning Corp.
Eagle-Picher Co.
Galigher Co.
Gates Engineering Co.
Goodall Rubber Co.
Koppers Co., Inc.
**LINATEX CORP. OF AMERICA**
Minnesota Mining & Mfg. Co.
Nalco Chemical Co.
National Electric Div., H. K. Porter Co., Inc.
Pennsalt Chemicals Corp.
**PHILADELPHIA QUARTZ CO.**
Reilly Tar & Chemical Corp.
Ruberoid Co.
Sika Chemical Corp.
Solar Aircraft Co.
**TEXACO INC.**
Tidewater Oil Co.
U. S. Stoneware Co.

### 140 Communications, Audible Signal (Bell, Buzzer, Horn, etc.) *also see below*

Bristol Co.
**MINE SAFETY APPLIANCES CO.**

### 141 Communications, Radio

Dresser-Ideco Co.
ITT Federal Div., International Tel. & Tel. Corp.
Motorola Communications & Electronics Inc.
Radio Corp. of America, Communications Products Dept.
**INDUSTRIAL PHYSICS & ELECTRONICS**
**MINE SAFETY APPLIANCES CO.**

### 142 Communications, Telephone

Dresser-Ideco Co.
**INDUSTRIAL PHYSICS & ELECTRONICS**
**MINE SAFETY APPLIANCES CO.**
Motorola Communications & Electronics, Inc.
Talk-A-Phone Co.

### 143 Communications, Television

Dage Television Div., Thompson, Ramo, Wooldridge Inc.
Dresser-Ideco Co.
KIN TEL
**MINE SAFETY APPLIANCES CO.**
Motorola Communications & Electronics Inc.
Special Instruments Laboratory Inc.

### 144 Communications, Visual signal (Light, Semaphore, etc.)—*also see* above and Rail Signals; does not include Signs)

**AMERICAN MINE DOOR CO.**
**CHEATHAM ELECTRIC SWITCHING DEVICE CO.**
Dresser-Ideco Co.
**INDUSTRIAL PHYSICS & ELECTRONICS**
**MINE SAFETY APPLIANCES CO.**
**NACHOD & U. S. SIGNAL CO.**

### 145 Computing Machines—does not include slide rules (see Drafting Equip.)

Geo Optic & Paper Corp.
Remington Rand Div., Sperry Rand Corp.
**WESTINGHOUSE ELECTRIC CORP.**

**(Concentrators—See Separators & Concentrators including Electrostatic; Heavy Media; Jigs; Tables; Magnetic and Spiral)**

### 146 Concrete Additives (Dispersants, Anti-Freeze, etc.)

Aluminum Co. of America
Eagle-Picher Co.
**HERCULES POWDER CO.**
**JOHNS-MANVILLE**
Marathon Div. American Can Co.
Master Builders Co.
Newport Industries Co., Heyden Newport Chemical Corp.
Onyx Chemical Corp.
Sika Chemical Corp.
Wyandotte Chemicals Corp., Michigan Alkali Div.

### 147 Concrete Forms (Prefab, Movable, etc.)

Blaw-Knox Co.
Erie Strayer Co.
**MAYO TUNNEL & MINE EQUIPMENT**

### 148 Concrete Grout Pumps

Air Placement Equipment Co.
Crossley Machine Co.
**DIAMOND DRILL CONTRACTING CO.**
Engineered Equipment Inc.
**HALLIBURTON OIL WELL CEMENTING**
**GARDNER DENVER CO.**
**MAYO TUNNEL & MINE EQUIPMENT**
Robbins & Myers Inc.
**SPRAGUE & HENWOOD, INC.**

### 149 Concrete (& similar material) Pumps, Slingers & Placers

Air Placement Equipment Co.
Cement Gun Co.
Chain Belt Co.
**CHICAGO PNEUMATIC TOOL CO.**
Crossley Machine Co.
Engineered Equipment Inc.
Remington Arms Co., Inc.

### 150 Concrete Sprayers & Blowers

Air Placement Equipment Co.
Engineered Equipment, Inc.

**(Condensers—see Coolers)**

**(Consultants — *see* Contractors; Laboratory Service; *also see* p 416)**

### 151 Continuous Miners & Planers—*also see* Drills (Rock) Special Large; does not include Cutting Machines; for bits, see Cutting Machine Bits

Goodman Mfg. Co.
**JOY MFG. CO.**
**MAYO TUNNEL & MINE EQUIPMENT**
**NATIONAL MINE SERVICE CO.**

### 152 Contractors, Aerial Survey (Exploration, mapping, etc.)

Abrams Aerial Survey Corp.
**AERO SERVICE CORP.**
Aero Service Corp. (Mid-Continent)
Aero Service Corp. (Western)
American Air Surveys Inc.
Amman, Jack, Inc., Engineers & Surveyors
Canadian Aero Service Ltd.
Fairchild Aerial Surveys, Inc.
Hunting Surveys Inc.
Hunting Surveys, Ltd.
Lundberg Explorations Ltd.
McClintock Co.
McPhar Geophysics, Ltd.

### 153 Contractors, Construction, Mineral Processing Plant

Arrowhead Steel Buildings, Inc.
Bechtal Corp.
Bigelow-Liptak Corp.
Booth Co., Inc.
Catalytic Construction Co.
Chemical Construction Corp.
Foley Brothers, Inc.
Frazier Davis Construction Co.
Hack Engineering Co.
**HALLIBURTON OIL WELL CEMENTING**
**KAISER ENGINEERS**
McDowell Co., Inc., Wellman Engineering Co.
Ridge Equipment Co.
Singmaster & Breyer Inc.
**STEARNS ROGER MFG. CO.**
Stone & Webster Engineering Corp.
**TREADWELL, M. H., CO., INC.**
Universal Dredge Mfg. Co.
Vulcan-Cincinnati, Inc.
Walvoord, O. W., Inc.
Winston Bros. Co.

### 154 Contractors, Construction, Piers & Wharves, Ore Handling et al

Bechtal Corp.
**DRAVO CORP.**
Foley Brothers, Inc.
Frazier Davis Construction Co.
**HALLIBURTON OIL WELL CEMENTING**
**KAISER ENGINEERS**
**LINK-BELT CO.**
McDowell Co., Inc., Wellman Engineering Co.
Singmaster & Breyer Inc.
**STEARNS ROGER MFG. CO.**
Stone & Webster Engineering Corp.
**TREADWELL, M. H., CO., INC.**

### 155 Contractors, Construction, Shaft & Tunnel

**DRAVO CORP.**
Foley Brothers Inc.
Frazier Davis Construction Co.
**HALLIBURTON OIL WELL CEMENTING**
Intrusion-Prepakt Inc.
**KAISER ENGINEERS**
**MACHINERY CENTER INC.**
Winston Bros. Co.

### 156 Contractors, Design, Mine

Bechtal Corp.
Industrial Engineering & Construction Co.
**KAISER ENGINEERS**
**LINK-BELT CO.**
**STEARNS ROGER MFG. CO.**
Winston Bros. Co.

### 157 Contractors, Design Mineral Processing Plant

Bechtal Corp.
Booth Co., Inc.
Catalytic Construction Co.
Chemical Construction Corp.
Chemical Separations Corp.
Fairmont Machinery Co.
Galigher Co.
**GOULD, GORDON I., CO.**
Hack Engineering Co.
**HALLIBURTON OIL WELL CEMENTING**
**KAISER ENGINEERS**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
McDowell Co., Inc., Wellman Engineering Co.
Singmaster & Breyer Inc.
Southwestern Engineering Co.
**STEARNS ROGER MFG. CO.**
Stone & Webster Engineering Corp.
**TREADWELL, M. H., CO. INC.**
Universal Dredge Mfg. Co.
Vulcan-Cincinnati Inc.
Walvoord, O. W., Inc.
Winston Bros. Co.

### 158 Contractors, Drilling (Exploration)

**ACKER DRILL CO., INC.**
Foley Brothers Inc.
Havlick, J. L.
**JOY MFG. CO.**
McClintock Co.
Minerals Engineering Co.
**SPRAGUE & HENWOOD INC.**

### 159 Contractors, Geological Service

**AERO SERVICE CORP.**
American Air Surveys Inc.
Canadian Aero Service Ltd.
**GEODYNAMICS INC.**
Geophysical Instrument & Supply
Hunting Survey Corp., Ltd.
Hunting Surveys Inc.
Hunting Surveys Ltd.
McPhar Geophysics Ltd.

### 160 Contractors, Geophysical Service

**AERO SERVICE CORP.**
Aero Service Corp. (Mid-Continent)
American Air Surveys Inc.
Canadian Aero Service Ltd.
**GEODYNAMICS INC.**
Geophysical Instrument & Supply
Hunting Survey Corp., Ltd.
Hunting Surveys Inc.
Hunting Surveys Ltd.
McPhar Geophysics Ltd.
Seismograph Service Corp.

### 161 Contractors, Ground Solidification & Cementation

**HALLIBURTON OIL WELL CEMENTING**
Winston Bros. Co.

### 162 Contractors, Mapping (Topo)

AGA Corp. of America
**AERO SERVICE CORP.**
Aero Service Corp. (Mid-Continent)
American Air Surveys Inc.
Ammann, Jack, Inc. Engineers & Surveyors
Canadian Aero Service Ltd.
Geodimeter Co.
Hunting Survey Corp., Ltd.
Hunting Surveys Inc.
Hunting Surveys Ltd.

### 163 Contractors, Mine & Prospect Examination & Valuation — *also see* Consultants

Chapman, Wood & Griswold Ltd.
Industrial Engineering & Construction Co.
Minerals Engineering Co.
Singmaster & Breyer Inc.
Southwestern Engineering Co.

### 164 Contractors, Mining Dredging

Acrow Corp. of America
Foley Brothers Inc.

### 165 Contractors, Mining, Open Pit

Bechtal Corp.
Foley Brothers Inc.
Southwestern Engineering Co.
Winston Bros. Co.

### 166 Contractors, Mining, Stripping

Bechtal Corp.
Foley Brothers Inc.
Winston Bros. Co.

### 167 Contractors, Mining Underground

Foley Brothers Inc.
Frazier Davis Construction Co.
Winston Bros. Co.

### 168 Controls Electrical & Electronic (Automatic, Remote Indicating, Recording, etc.)—*also see* Meters; Communications

Allen-Bradley Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Automatic Switch Co.
B-I-F Industries Inc.
**BAILEY METER CO.**
Bristol Co.
**CLARK CONTROLLER CO.**
Cutler-Hammer Inc.
Daystrom Inc., Weston Instruments Div.
Dietz, Henry G., Co., Inc.
Durakool Inc.
Electric Machinery Mfg. Co.
Erie Strayer Co.
**FOXBORO CO.**
Fuller Co.
General Electric Co., Apparatus Sales Div.
Hagan Chemicals & Controls Inc., Calgon Co., Hall Laboratories
**HARDINGE CO., INC.**
Howe Scale Co., American Mfg. Co., Inc.
Ideal Electric & Mfg. Co.
**INDUSTRIAL PHYSICS & ELECTRONICS**
Infilco Inc.
Leeds & Northrup Co.
Metron Instrument Co.
**MINE SAFETY APPLIANCES CO.**
Minneapolis-Honeywell Regulator
Minneapolis-Honeywell Regulator Brown Instrument Div.
OPW-Jordan Corp.
Paragon Electric Co.
Precision Thermometer & Instrument Co.
Reliance Electric & Engineering
Revere Corp. of America, Neptune Meter Co.
Southwestern Industrial Electronics Co.
Special Instruments Laboratory Inc.
Union Switch & Signal, Westinghouse Air Brake Co.
Vapor Recovery Systems Co.
Webb, Jervis B., Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 169 Controls, Hydraulic & Pneumatic (Auto. Remote, etc.) — *also see* Meters

American Brake Shoe Co.
Automatic Switch Co.
B-I-F Industries Inc.
**BAILEY METER CO.**
Bristol Co.
Cutler-Hammer Inc.
Daystrom Inc., Weston Instruments Div.
**FOXBORO CO.**
**GARDNER DENVER CO.**
Hagan Chemicals & Controls Inc., Calgon Co., Hall Laboratories
Leeds & Northrup Co.
McDowell Co., Inc., Wellman Engineering Co.
Megator Corp.
Minneapolis-Honeywell Regulator
Minneapolis-Honeywell Regulator, Brown Instrument Div.
National Supply Co.
OPW-Jordan Corp.
Oilgear Co.
Owatonna Tool Co.
Precision Thermometer & Instrument Co.
Rockiron Co., Ltd.
Vapor Recovery Systems Co.
Vickers Inc.
Webb, Jervis B., Co.
Westinghouse Air Brake Co., Ind. Products Div.

### 170 Converters, Metal (equipment not service)

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**TRAYLOR ENGRG. & MFG. CO.**
**TREADWELL, M. H., CO., INC.**

### 171 Conveyor Belting

**ACME HAMILTON MFG. CORP.**
**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
American Rubber Mfg. Co.
**BARBER-GREENE CO.**
Bitco Inc.
Bonded Scale & Machine Co.
Cambridge Wire Cloth Co.
Cincinnati Rubber Mfg. Co., Div., Thor Power Tool Co.
Daniels, C. R., Inc.
Extremultus Inc.
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**GOODYEAR TIRE & RUBBER CO.**
**HEWITT-ROBINS INC.**
**IOWA MFG. CO**
Megator Corp.
Mercer Rubber Co.
**NATIONAL MINE SERVICE CO.**
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.**
Republic Rubber Div., Lee Rubber & Tire Corp.
Russell Mfg.
Sandvik Steel Inc., Steel Belt Conveyor Dept.
Sandvik Steel Inc.
Thermoid Div., H. K. Porter Co., Inc.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
West Virginia Belt Repairs Inc.
**WICKWIRE SPENCER STEEL DIV. COLORADO FUEL & IRON CORP.**

### 172 Conveyor Belting Fasteners

American Rubber Mfg. Co.
Armstrong, Bray & Co.
**AUTOMATIC VULCANIZERS CO.**
Bitco Inc.
Bonded Scale & Machine Co.
Crescent Belt Fastener Co.
**FLEXIBLE STEEL LACING CO.**
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**NATIONAL MINE SERVICE CO.**
Northern Conveyor Co.
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.**

### 173 Conveyor Belting Vulcanizers

**AUTOMATIC VULCANIZERS CO.**
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
Heintz Mfg. Co.
**LINATEX CORP. OF AMERICA**
West Virginia Belt Repairs Inc.

### 174 Conveyors, Belt — for belting alone, see Conveyor Belting

Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Cambridge Wire Cloth Co.
Carpco Mfg. Inc.
Chain Belt Co.
Christian, J. D., Engineers
Continental Conveyor & Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Engineered Equipment Inc.
Goodman Mfg. Co.
**HEWITT-ROBINS, INC.**
Howe Scale Co., American Mfg. Co., Inc.
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Long-Airdox Co., Marmon-Herrington Inc.
Megator Corp.
**NATIONAL IRON CO.**
**NATIONAL MINE SERVICE CO.**
Northern Conveyor Co.
Ogden Iron Works Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
Pioneer Engineering Div., Poor & Co., Inc.
Richardson Scale Co.
Ridge Equipment Co.

Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.
Rockiron Co., Ltd.
Rogers Iron Works Co.
Sandvik Steel Inc., Steel Belt Conveyor Dept.
Smith Engineering Works
Standard Metal Mfg. Co.
**STURTEVANT MILL CO.**
**TREADWELL, M. H., CO., INC.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Universal Engineering Corp.
Universal Road Machinery Co.
Webb, Jervis B., Co.

### 175 Conveyors, Belt, Accessories (Cleaners, Moldboards, etc.)

**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Chain Belt Co.
Continental Conveyor & Equipment Co.
Fairmont Machinery Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**MCNALLY PITTSBURG MFG. CORP.**
Owatonna Tool Co.
Pioneer Engineering Div., Poor & Co., Inc.
Rogers Iron Works Co.
Stephens-Adamson Mfg. Co.
Universal Engineering Corp.

### 176 Conveyors, Belt Holdbacks

**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, J. D., Engineers
Continental Conveyor & Equipment Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Marland One-Way Clutch Co.
Rogers Iron Works Co.
Stephens-Adamson Mfg. Co.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 177 Conveyors, Belt, Idlers & Pulleys

**BARBER-GREENE CO.**
Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, J. D., Engineers
Columbus Conveyor Co.
Continental Conveyor & Equipment Co.
Davis Foundry & Machine Works
Denver Equipment Co.
Dodge Mfg. Corp.
Fairmont Machinery Co.
Goodman Mfg. Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Irwin Sensenich Corp.
Jeffrey Mfg. Co.
**JOY MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Long-Airdox Co., Marmon-Herrington Inc.
**McNALLY PITTSBURG MFG. CORP.**
Megator Corp.
Northern Conveyor Co.
Ogden Iron Works Co.
Pettibone Mulliken Corp.
Pickard Industries Inc., Central Mine Supply Co., Div.
Pioneer Engineering Div., Poor & Co., Inc.
Rockiron Co., Ltd.
Rogers Iron Works Co.
Sandvik Steel Inc.
Standard Metal Mfg. Co.
Stephens-Adamson Mfg. Co.
Universal Engineering Corp.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 178 Conveyors, Belt, Take-Ups

**BARBER-GREENE CO.**
Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Continental Conveyor & Equipment Co.
Dodge Mfg. Corp.
Goodman Mfg. Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**Joy Mfg. Co.**
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**McNALLY PITTSBURG MFG. CORP.**
Ogden Iron Works Co.
Pickard Industries Inc., Central Mine Supply Co., Div.
Pioneer Engineering Div., Poor & Co., Inc.
Rogers Iron Works Co.
Sandvik Steel Inc.
Stephens-Adamson Mfg. Co.
Universal Engineering Corp.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 179 Conveyors, Belt, Trippers

**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Continental Conveyor & Equipment Co.
Fairmont Machinery Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
**McNALLY PITTSBURG MFG. CORP.**
Ogden Iron Works Co.
Rogers Iron Works Co.
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 180 Conveyors (& Elevators), Bucket—does not include Conveyors, Trolley; or digging type (see Loaders)

B-I-F Industries Inc.
**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Carpco Mfg. Inc.
Chain Belt Co.
Christian, J. D., Engineers
Continental Conveyor & Equipment Co.
Columbus Conveyor Co.
Denver Equipment Co.
Engineered Equipment Inc.
Erie Strayer Co.
Fairmont Machinery Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
**McNALLY PITTSBURG MFG. CORP.**
Meckum Engineering Inc.
**NATIONAL IRON CO.**
Northern Conveyor Co.
Ogden Iron Works Co.
Ridge Equipment Co.
Rogers Iron Works Co.
Smith Engineering Works
Standard Metal Mfg. Co.
Stephens-Adamson Mfg. Co.
**STURTEVANT MILL CO.**
**TREADWELL, M. H., CO., INC.**
Union Chain & Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**

### 181 Conveyors, Chain (Drag-Scraper), (Bulk) — does not include Dragline Scraper-Slusher; or digging type (see Loaders)

American Chain Div., American Chain & Cable Co., Inc.
Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Columbus Conveyor Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Continental Conveyor & Equipment Co.
Fairmont Machinery Co.
Guyan Machinery Co.
Industrial Engineering & Construction Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**McNALLY PITTSBURG MFG. CORP.**
Northern Conveyor Co.
Ridge Equipment Co.
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.
Rockiron Co., Ltd.
**TREADWELL, M. H., CO., INC.**
Union Chain & Mfg. Co.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 182 Conveyors, Chain (Package)

Bonded Scale & Machine Co.
Chain Belt Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
Guyan Machinery Co.
Hack Engineering Co.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
Northern Conveyor Co.
**TREADWELL, M. H., CO., INC.**
Union Chain & Mfg. Co.
Universal Dredge Mfg. Co.
Watt Car & Wheel Co.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 183 Conveyors, Extensible

**BARBER-GREENE CO.**
Bitco Inc.
Christian, J. D., Engineers
Goodman Mfg. Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**WESTERN CONVEYOR CO.**

### 184 Conveyors, Loading Boom & Stacker—does not include small digging type (see Loaders); or Cranes; Overhead Traveling Gantry; Bridge; Monorail; Etc.

**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Christian, J. D., Engineers
Diamond Iron Works Div., Goodman Mfg. Co.
Fairmont Machinery Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
**McNALLY PITTSBURG MFG. CORP.**
Pioneer Engineering Div., Poor & Co., Inc.
Rogers Iron Works Co.
Stephens-Adamson Mfg. Co.
**TREADWELL, M. H., CO., INC.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Vulcan-Cincinnati Inc.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 185 Conveyors, Mobile (including Self-propelled—does not include digging type (see Loaders)

**BARBER-GREENE CO.**
Bonded Scale & Machine Co.
Christian, J. D., Engineers
Diamond Iron Works Div., Goodman Mfg. Co.
Erie Strayer Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Goodman Mfg. Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Long-Airdox Co., Marmon-Herrington Inc.

Pioneer Engineering Div., Poor & Co., Inc.
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**
**WESTERN GEAR CORP., INDUSTRIAL PDTS., DIV.**

### 186 Conveyors Movable, *also see* Conveyors, Mobile; does not include digging type (see Loaders)

**BARBER-GREENE CO.**
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Christian, J. D., Engineers
Engineered Equipment Inc.
Erie Strayer Co.
**FAIRBANKS, MORSE & CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Goodman Mfg. Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
**JOY MFG. CO.**
Lake Shore Inc., Lake Shore Engineering Div.
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Long-Airdox Co., Marmon-Herrington Inc.
Pioneer Engineering Div., Poor & Co., Inc.
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**
**WESTERN GEAR CORP., INDUSTRIAL PDTS., DIV.**

### 187 Conveyors, Pan & Apron

Bitco Inc.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, J. D., Engineers
Columbus Conveyor Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Continental Conveyor & Equipment Co.
Denver Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Fairmont Machinery Co.
Frog, Switch & Mfg. Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
Irwin Sensenich Corp.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**McNALLY PITTSBURG MFG. CORP.**
**NATIONAL IRON CO.**
Ogden Iron Works Co.
Pioneer Engineering Div., Poor & Co., Inc.
Roberts & Schaefer Co., Div, Thompson-Starrett Co., Inc.
Stephens-Adamson Mfg. Co.
Taylor Wharton Div., Harsco Corp.
**TRAYLOR ENGRG. & MFG. CO.**
**TREADWELL, M. H., CO., INC.**
Union Chain & Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 188 Conveyors, Pneumatic

Convair Inc.
Fuller Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Robinson Pneumatic Conveyor Systems
U. S. Hoffman Machinery Corp., Air Appliance Div.

### 189 Conveyors, Roller, Gravity & Powered (Packaged)

Bitco Inc.
Bonded Scale & Machine Co.
Christian, J. D., Engineers
**GATES RUBBER CO.**
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
**TREADWELL, M. H., CO., INC.**
Webb, Jervis B., Co.
**WESTERN CONVEYOR CO.**

### 190 Conveyors, Screw or Spiral

Bitco Inc.
Bonded Scale & Machine Co.
Carpco Mfg. Inc.
Central Mine Equipment Co.
Christian, J. D., Engineers
Columbus Conveyor Co.
Continental Conveyor & Equipment Co.
Erie Strayer Co.
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Long-Airdox Co., Marmon-Herrington Inc.
**McNALLY PITTSBURG MFG. CORP.**
Richardson Scale Co.
Stephens-Adamson Mfg. Co.
**STURTEVANT MILL CO.**
**TREADWELL, M. H., CO., INC.**
Universal Dredge Mfg. Co.
Watt Car & Wheel Co.
**WESTERN CONVEYOR CO.**

### 191 Conveyors Sectional Prefab—does not include Conveyors, Movable

**BARBER-GREENE CO.**
Bonded Scale & Machine Co.
Chain Belt Co.
Christian, J. D., Engineers
Continental Conveyor & Equipment Co.
Erie Strayer Co.
Fairmont Machinery Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
Lake Shore Inc., Lake Shore Engineering Div.
**LINK-BELT CO.**
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Watt Car & Wheel Co.
**WESTERN CONVEYOR CO.**

### 192 Conveyors, Shaking & Vibrating — *also see* Feeders

Ajax Flexible Coupling Co.
Carpco Mfg. Inc.
Chain Belt Co.
Cleveland Vibrator Co.
**DIESEL ENERGY CORP.**
Fairmont Machinery Co.
Goodman Mfg. Co.
Hack Engineering Co.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Ridge Equipment Co.
Simplicity Engineering Co.
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**

### 193 Conveyors, Trolley — does not include aerial Cableways

Columbus McKinnon Chain Corp., Mining Equipment Div.
**LINK-BELT CO.**
Louden Machinery Co.
Webb, Jervis B., Co.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 194 Coolers (& Condensers), Cooling Towers, Liquid & Gas Process — does not include Air Compressor Aftercoolers

American Standard Industrial Div.
Arrow Tank Co.
**BETHLEHEM STEEL CO.**
Carrier Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Infilco Inc.
Ready Power Co.
Santa Fe Tank Div., Fluor Products Co.

### 195 Coolers, Solids

Christian, J. D., Engineers
Fuller Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HARDINGE CO., INC.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Silver Engineering Works Inc.
**STANDARD STEEL CORP.**
**STEARNS ROGER MFG. CO.**
**TRAYLOR ENGRG. & MFG. CO.**

### (Core Barrels—see Drills)

### (Couplers, Mine Car — see Car Couplers)

### (Couplings—see *below; also see* Drill Rod; Pipe Fittings)

### 196 Couplings, Mechanical Power Transmission — *see below; also see* Clutches; Drives; Hubs)

American Standard Industrial Div.
Bitco Inc.
Browning Mfg. Co.
Chain Belt Co.
Christian, J. D., Engineers
Diamond Chain Co., Inc.
Dodge Mfg. Corp.
Dominion Engineering Co., Ltd.
Flood City Brass & Elec. Co.
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Lovejoy Flexible Coupling Co.
Morse Chain Co., Borg-Warner Industry
National Supply Co.
Twin Disc Clutch Co.
Union Chain & Mfg. Co.

### 197 Couplings, M. P. T., Flexible

Ajax Flexible Coupling Co.
American Standard Industrial Div.
Atlas Chain & Mfg. Co.
Bitco Inc.
Browning Mfg. Co.
Chain Belt Co.
Continental Conveyor & Equipment Co.
Diamond Chain Co., Inc.
Dodge Mfg. Corp.
Dominion Engineering Co., Ltd.
F. A. B. Mfg. Co.
**FALK CORP.**
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
Guyan Machinery Co.
**HEWITT-ROBINS INC.**
Jeffrey Mfg. Co.
Koppers Co., Inc., Metal Prod. Div.
**LINK-BELT CO.**
Morse Chain Co., Borg-Warner Industry
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**

### 198 Couplings, M. P. T., Rigid

Ajax Flexible Coupling Co.
Bitco Inc.
Browning Mfg. Co.
Chase Brass & Copper Co.
Continental Conveyor & Equipment Co.
Dodge Mfg. Corp.
**LINK-BELT CO.**
Morse Chain Co., Borg-Warner Industry
OPW-Jordan Corp.
Stratoflex Inc.
Tool Steel Gear & Pinion Co.
Weatherhead Co., Fort Wayne Div.

### 199 Cranes, Non-Revolving Jib & Revolving Derrick, Unmounted (under 10-Ton Lift)

American Chain & Cable Co., Wright Hoist Div.
Baker Industrial Trucks Div., Otis Elevator Co.
Guyan Machinery Co.
Hack Engineering Co.
Harrington Co.
Manning, Maxwell & Moore Inc., Shaw Box Crane & Hoist Div.
Orton Crane & Shovel Co.
Reading Crane & Hoist Corp.

Shepard Niles Crane & Hoist Corp.
Universal Dredge Mfg. Co.

### 200 Cranes, Non-Revolving Jib, Vehicle Mounted (Over 10-Ton)

Bucyrus-Erie Co.
Guyan Machinery Co.
Orton Crane & Shovel Co.
Stanco Mfg. Corp.

### 201 Cranes, Overhead Traveling, Gantry, Bridge, Monorail, etc.

American Chain & Cable Co., Wright Hoist Div.
**AMERICAN HOIST & DERRICK CO.**
Chisholm-Moore Hoist Div., Columbus McKinnon Chain Corp.
Columbus McKinnon Chain Corp., Mining Equipment Div.
**DRAVO CORP.**
Forker Corp.
Guyan Machinery Co.
Hack Engineering Co.
**HARNISCHFEGER CORP.**
Harrington Co.
Louden Machinery Co.
Manning, Maxwell & Moore Inc., Shaw Box Crane & Hoist Div.
McDowell Co., Inc., Wellman Engineering Co.
Pacific Coast Engineering Co.
Reading Crane & Hoist Corp.
Robbins & Myers Inc.
Round & Son Inc.
Shepard Niles Crane & Hoist Corp.
**STEARNS ROGER MFG. CO.**
Universal Dredge Mfg. Co.
Washington Iron Works
Webb, Jervis B., Co.
Whiting Corp.

### 202 Cranes, Revolving Derrick, Crawler, Locomotive & Wheeled

**AMERICAN HOIST & DERRICK CO.**
Anthony Co.
Austin-Western Construction Equipment Div.
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bucyrus-Erie Co.
**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV.**
Dominion Engineering Co., Ltd.
**HARNISCHFEGER CORP.**
Koehring Co.
**LINK-BELT SPEEDER CORP.**
**MACHINERY CENTER INC.**
**MANITOWOC ENGINEERING CORP.**
**MARION POWER SHOVEL CO., UNIVERSAL MARION CORP.**
McDowell Co., Inc., Wellman Engineering Co.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Quick-Way Truck Shovel Co.
Schield Bantam Co.
Thew Shovel Co.
Unit Crane & Shovel Corp.
Washington Iron Works

### 203 Cranes, Revolving Derrick, Stationary (Over 10-Ton)

**AMERICAN HOIST & DERRICK CO.**
Austin-Western Construction Equipment Div.
Bucyrus-Erie Co.
**DRAVO CORP.**
Manning, Maxwell & Moore Inc., Shaw Box Crane & Hoist Div.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Shepard Niles Crane & Hoist Corp.
Unit Crane & Shovel Corp.
Washington Iron Works

### 204 Crankshafts Diesel Engine

Ladish Co.

### 205 Crusher Parts

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Atlas Steel Casting Co.
**BALDWIN-LIMA-HAMILTON CORP. STANDARD STEEL WORKS DIV.**
Bonded Scale & Machine Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Dominion Engineering Co., Ltd.
**ELECTRIC STEEL FOUNDRY CO.**
Frog, Switch & Mfg. Co.
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Ladish Co.
Meehanite Corp.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
**NORDBERG MFG. CO.**
Pettibone Mulliken Corp.
Smith Engineering Works
Sorel Steel Foundries Ltd.
Stroh Process Steel Co.
Taylor Wharton Div., Harsco Corp.
Thomas Foundries Inc.
Tool Steel Gear & Pinion Co.
**TRAYLOR ENGRG. & MFG. CO.**
Universal Engineering Corp.

### 206 Crushers, Cone

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**AUTOMATIC VULCANIZERS CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HAMMERMILLS INC.**
**IOWA MFG. CO.**
Kloeckner-Humboldt-Deutz AG
**NORDBERG MFG. CO.**
Smith Engineering Works
**STRAUBE MFG. CO.**
**TRAYLOR ENGRG. & MFG. CO.**
Universal Engineering Corp.

### 207 Crushers, Disk

**NORDBERG MFG. CO.**
**STURTEVANT MILL CO.**

### 208 Crushers, Gyratory

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Lippmann Engineering Works Inc.
**McNALLY PITTSBURG MFG. CORP.**
**NORDBERG MFG. CO.**
Pennsylvania Chrusher Div., Bath Iron Works Corp.
Smith Engineering Works
Southwestern Engineering Co.
Stephens-Adamson Mfg. Co.
**STRAUBE MFG. CO.**
**TRAYLOR ENGRG. & MFG. CO.**

### 209 Crushers, Hammer

**ALLIS-CHALMERS MFG. CO..INDUSTRIES GROUP**
American Pulverizer Co.
Diamond Iron Works Div., Goodman Mfg. Co.
**DIESEL ENERGY CORP.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Lippmann Engineering Works Inc.
Pennsylvania Crusher Div., Bath Iron Works Corp.
Pioneer Engineering Div., Poor & Co., Inc.
Pulva Corp.
Rogers Iron Works Co.
**STURTEVANT MILL CO.**
Universal Engineering Corp.

### 210 Crushers, Impact

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
American Pulverizer Co.
Frog, Switch & Mfg. Co.
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**NORDBERG MFG. CO.**
Pennsylvania Crusher Div., Bath Iron Works Corp.
Pioneer Engineering Div., Poor & Co., Inc.
Pulva Corp.
Rogers Iron Works Co.
Simplicity Engineering Co.
Southwestern Engineering Co.
Stephens-Adamson Mfg. Co.
**STURTEVANT MILL CO.**
Universal Engineering Corp.

### 211 Crushers, Jaw

Abbé Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bico Inc.,
**BIRDSBORO CORP.**
Black's Machine Shop
Denver Equipment Co.
Denver Fire Clay Co.
Diamond Iron Works Div., Goodman Mfg. Co.
**DIESEL ENERGY CORP.**
Dominion Engineering Co., Ltd.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HAMMERMILLS INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Lippmann Engineering Works Inc.
**McLANAHAN & STONE CORP.**
**MORSE BROS. MACHINERY CO.**
Pennsylvania Crusher Div., Bath Iron Works Corp.
Pioneer Engineering Div., Poor & Co., Inc.
Rogers Iron Works Co.
Smith Engineering Works
**STRAUBE MFG. CO.**
Stroh Process Steel Co.
**STURTEVANT MILL CO.**
**TRAYLOR ENGRG. & MFG. CO.**
Universal Engineering Corp.
Universal Road Machinery Co.

### 212 Crushers, Mobile Units

**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bonded Scale & Machine Co.
Denver Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Hack Engineering Co.
**IOWA MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Lippmann Engineering Works Inc.
**NORDBERG MFG. CO.**
Pioneer Engineering Div., Poor & Co., Inc.
Rogers Iron Works Co.
**STRAUBE MFG. CO.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.

### 213 Crushers, Ring Roll

Abbé Engineering Co.
American Pulverizer Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**STURTEVANT MILL CO.**

### 214 Crushers, Roll

Abbé Engineering Co.
**McLANAHAN & STONE CORP.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bonded Scale & Machine Co.
Denver Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Exolon Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Gundlach Machine Co., JMJ Industries Inc.
**HAMMERMILLS INC.**
Iowa Mfg. Co.
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
**McNALLY PITTSBURG MFG. CORP.**
**MORSE BROS. MACHINERY CO.**
Pennsylvania Crusher Div., Bath Iron Works Corp.
Pioneer Engineering Div., Poor & Co., Inc.
Pulva Corp.
Ridge Equipment Co.
Rogers Iron Works Co.
Smith Engineering Works
**STURTEVANT MILL CO.**
**TRAYLOR ENGRG. & MFG. CO.**
Universal Engineering Corp.

### 215 Cutting Machine Bits (Rock)

Bay State Abrasive Products Co.
Central Mine Equipment Co.
Metallurgical Products Dept., General Electric Co.
Vascoloy-Ramet Corp.

### 216 Cutting Machine Parts (Rock)

JOY MFG. CO.

### 217 Cutting Machines (Rock) —does not include Continuous Miners & Planers

JOY MFG. CO.
Kersey Mfg. Co., Inc.

### (Cyanide—see Chemicals)

### 218 Cyaniding Process Equipment (Special) — does not include standard auxiliary equipment

Denver Equipment Co.
MORSE BROS. MACHINERY CO.

### (Cyclones—see Classifiers)

### 219 Cylinders, Air & Hydraulic

Anthony Co.
B-I-F Industries Inc.
BAILEY METER CO.
Benton Harbor Engineering Works Inc.
CARD, C. S., IRON WORKS
Cessna Aircraft Co.
Commercial Shearing & Stamping Co.
Galland Henning Mfg. Co.
Nopak Div.
GENERAL AMERICAN TRANSPORTATION CORP.
Ledeen Mfg. Co.
MACHINERY CENTER INC.
McDowell Co., Inc., Wellman Engineering Co.
Minneapolis-Honeywell Regulator
Oilgear Co.
Owatonna Tool Co.
Rockiron Co., Ltd.
Vickers Inc.
Wagner Electric Corp.
Westinghouse Air Brake Co.
Ind. Products Div.

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### 220 Diamond Concentrating Equipment (Special) — does not include standard auxiliary equipment

Hack Engineering Co.
Universal Dredge Mfg. Co.

### 221 Diamonds, Industrial

American Coldset Corp.
DIAMOND TOOL RESEARCH CO., INC.
Koebel Diamond Tool Co.
Metallurgical Products Dept., General Electric Co.
SMIT, ANTON & CO.
SMIT, J. K., & SONS INC.
SPRAGUE & HENWOOD INC.
WHEEL TRUEING TOOL CO.

### (Doors, Mine — see Mine Doors)

### 222 Drafting Equipment & Supplies—*also see* Blue Photo & White Print Machines

Geo Optic & Paper Corp.
Geophysical Instrument & Supply
Kern Instruments Inc.
Miller, David, & Associates
Frederick Post Co.
Stratex Instrument Co.
Warren-Knight Co.

### (Draglines—see Excavators)

### 223 Dredges, Bucketline

ELLICOTT MACHINE CORP.
Meckum Engineering Inc.
Washington Iron Works

### 224 Dredges, Dipper Shovel

ELLICOTT MACHINE CORP.
MANITOWOC ENGINEERING CORP.
Sorel Steel Foundries Ltd.

### 225 Dredges, Dragline & Grab Crane

Dominion Engineering Co., Ltd.
ELLICOTT MACHINE CORP.
Hack Engineering Co.
MANITOWOC ENGINEERING CORP.
Universal Dredge Mfg. Co.

### 226 Dredges, Suction

Acrow Corp. of America
AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.
BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.
Eagle Iron Works
ELLICOTT MACHINE CORP.
Hack Engineering Co.
Meckum Engineering Inc.
MORRIS MACHINE WORKS
Pacific Coast Engineering Co.
Universal Dredge Mfg. Co.

### 227 Dredge Hulls—*also see* Barges

BETHLEHEM STEEL CO.
Eastern Steel Plate Fabricators Inc.
ELLICOTT MACHINE CORP.
Meckum Engineering Inc.
Pacific Coast Engineering Co.

### 228 Dredge Sleeves

American Rubber Mfg. Co.
BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.
ELLICOTT MACHINE CORP.
GOODRICH, B. F., INDUSTRIAL PRODS. CO.
RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.

### 229 Drill (Rock) Bits, Auger

ACKER DRILL CO., INC.
BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.
Central Mine Equipment Co.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
Guyan Machinery Co.
Long-Airdox Co., Marmon-Herrington Inc.
Mayhew Machine & Supply Co.
Metallurgical Products Dept., General Electric Co.
Salem Tool Co.
Vascoloy-Ramet Corp.

### 230 Drill (Rock) Bits (& Stems), Churn

ACKER DRILL CO. INC.
Bucyrus-Erie Co.
Hillman, C. Kirk, Co., Inc.
Spang & Co.

### 231 Drill (Rock) Bits, Core

ACKER DRILL CO., INC.
Boyles Bros. Drilling Co., Ltd.
CHICAGO PNEUMATIC TOOL CO.
CHRISTENSEN DIAMOND PRODUCTS CO.
Failing, George E., Co.
GARDNER DENVER CO.
Havlick, J. L.
HOFFMAN BROS. DRILLING CO.
Hughes Tool Co.
JOY MFG. CO.
Kennametal Inc., Mining Tool Div.
LONGYEAR CO.
Mayhew Machine & Supply Co.
MOBILE DRILLING INC.
Norton Co.
SMIT, ANTON & CO.
SMIT, J. K., & SONS INC.
SPRAGUE & HENWOOD INC.
WHEEL TRUEING TOOL CO.

### 232 Drill (Rock) Bits, Diamond

ACKER DRILL CO., INC.
American Coldset Corp.
Boyles Bros. Drilling Co., Ltd.
CHICAGO PNEUMATIC TOOL CO.
CHRISTENSEN DIAMOND PRODUCTS CO.
DIAMOND DRILL CONTRACTING CO.
Diamond Products Inc.
DIAMOND TOOL RESEARCH CO., INC.
Failing, George E., Co.
HOFFMAN BROS. DRILLING CO.
JOY MFG. CO.
Koebel Diamond Tool Co.
LONGYEAR CO.
McClintock Co.
Metal Carbides Corp.
MOBILE DRILLING INC.
Norton Co.
SMIT, ANTON & CO.
SMIT, J. K, & SONS INC.
SPRAGUE & HENWOOD INC.
Stanco Mfg. Corp.
Varel Mfg. Co.
WHEEL TRUEING TOOL Co.

### 233 Drill (Rock) Bits, Diamond, Resetting Service

ACKER DRILL CO., INC.
American Coldset Corp.
Boyles Bros. Drilling Co., Ltd.
CHRISTENSEN DIAMOND PRODUCTS CO.
DIAMOND DRILL CONTRACTING CO.
Diamond Products Inc.
DIAMOND TOOL RESEARCH CO., INC.
HOFFMAN BROS. DRILLING CO.
JOY MFG. CO.
Koebel Diamond Tool Co.
LONGYEAR CO.
McClintock Co.
Metal Carbides Corp.
MOBILE DRILLING INC.
SMIT, ANTON & CO.
SMIT, J. K., & SONS INC.
SPRAGUE & HENWOOD INC.
Varel Mfg. Co.
WHEEL TRUEING TOOL CO.

### 234 Drill (Rock) Bits, percussion

ATLAS COPCO
Bitco Inc.
Black's Machine Shop
BRUNNER & LAY-EASTERN, INC.
CHICAGO PNEUMATIC TOOL CO.
CHRISTENSEN DIAMOND PRODUCT CO.
Fagersta Steels Inc.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
LeROI DIV., WESTINGHOUSE AIR BRAKE CO.
Mayhew Machine & Supply Co.
Metal Carbides Corp.
MISSION MFG. CO.
MOBILE DRILLING INC.
Spang & Co.
Thompson Products Ltd.
THOR POWER TOOL CO.
TIMKEN ROLLER BEARING CO.
Vascoloy-Ramet Corp.
WESTERN ROCK BIT MFG. CO.

### 235 Drill (Rock) Bits, Rotary, Roller Cone

ACKER DRILL CO., INC.
Bitco, Inc.
BRUNNER & LAY-EASTERN, INC.
CHICAGO PNEUMATIC TOOL CO.
DIAMOND DRILL CONTRACTING CO.
Failing, George E., Co.
Hughes Tool Co.
LONGYEAR CO.
Mayhew Machine & Supply Co.
Metallurgical Products Dept., General Electric Co.
MOBILE DRILLING INC.
Robbins Machine & Mfg. Co.
Salem Tool Co.
Smith Tool Co.
Varel Mfg. Co.

### 236 Drill (Rock) Bits, Rotary Drag, Large Hole (+4-in.), Quarry & Well (Spade, Prong, Etc.)

ACKER DRILL CO., INC.
Bitco Inc.
Failing, George E., Co.
GARDNER DENVER CO.
Hawthorne Inc.
Kennametal Inc., Mining Tool Div.
MOBILE DRILLING INC.
Salem Tool Co.
Varel Mfg. Co.
Vascoloy-Ramet Corp.

### 237 Drill (Rock) Bits, Rotary Drag, Small Hole (-4-in.) (Spade, Prong, Etc.)

ACKER DRILL CO., INC.
Bitco Inc.
Firth Sterling Inc.
GARDNER DENVER CO.
Hawthorne Inc.
Kennametal Inc., Mining Tool Div.
Mayhew Machine & Supply Co.
MOBILE DRILLING INC.
Salem Tool Co.
Varel Mfg. Co.
Vascoloy-Ramet Corp.

### 238 Drill (Rock) Bit & Steel Forging & Heat Treating Furnaces

Bitco Inc.



### 263 Drills (Rock) Percussion

Schramm, Inc.

### 264 Drills (Rock) Rotary

Bucyrus-Erie Co.
Gardner-Denver Co.
Ingersoll-Rand Co.
Joy Mfg. Co.
Le Roi Div., Westinghouse Air Brake Co.
Schramm, Inc.
Thor Power Tool Co.
Timken Roller Bearing Co.
Western Gear Corp., Industrial

Central Mine Equipment Co.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
Thompson Products Ltd.

### 239 Drill (Rock) Bit & Steel Forging Hammers

Bitco Inc.
GARDNER DENVER CO.
INGERSOLL-RAND CO.

### 240 Drill (Rock) Bit & Steel Grinders

ATLAS COPCO
Bitco Inc.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
Mayhew Machine & Supply Co.
WESTERN ROCK BIT MFG. CO.

### 242 Drill (Rock) Booms, Extensible & Mobile—*also see* Booms & Towers; Drill (Rock) Jumbos

Bucyrus-Erie Co.
CHICAGO PNEUMATIC TOOL CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
MACHINERY CENTER INC.
Rogers Iron Works Co.

### 243 Drill (Rock) Core Barrels

ACKER DRILL CO., INC.
Boyles Bros. Drilling Co., Ltd.
CHICAGO PNEUMATIC TOOL CO.
CHRISTENSEN DIAMOND PRODUCTS CO.
DIAMOND DRILL CONTRACTING CO.
Failing, George E., Co.
HOFFMAN BROS. DRILLING CO.
JOY MFG. CO.
LONGYEAR CO.
Mayhew Machine & Supply Co.
MOBILE DRILLING, INC.
SPRAGUE & HENWOOD, INC.

### 244 Drill (Rock) Dust Collectors (Small Hole Drills)

Aerotec Industries Inc.
DUCON CO., INC.
Failing, George E., Co.
Fletcher, J. H., & Co.
INGERSOLL-RAND CO.
LeROI DIV. WESTINGHOUSE AIR BRAKE CO.
THOR POWER TOOL CO.

### 245 Drill (Rock) Dust Collectors (Quarry Drills)

Aerotec Industries Inc.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
Mayhew Machine & Supply Co.
MINE SAFETY APPLIANCES CO.
THOR POWER TOOL CO.

### 246 Drill (Rock) Jumbos & Wagons — *also see* Booms & Towers; Drill (Rock) Booms

CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
LeROI DIV. WESTINGHOUSE AIR BRAKE CO.
MACHINERY CENTER INC.
MAYO TUNNEL & MINE EQUIPMENT
Rockiron Co., Ltd.
Rogers Iron Works Co.
Schramm, Inc.
THOR POWER TOOL CO.
Winter Weiss Co.

### 247 Drill (Rock) Rods, Diamond

ACKER DRILL CO., INC.
American Coldset Corp.
Boyles Bros. Drilling Co., Ltd.
CHICAGO PNEUMATIC TOOL CO.
DIAMOND DRILL CONTRACTING CO.
HOFFMAN BROS. DRILLING CO.
JOY MFG. CO.
LONGYEAR CO.
McClintock Co.
MOBILE DRILLING INC.
SMIT, ANTON & CO.
SPRAGUE & HENWOOD INC.

### 248 Drill (Rock) Rods, Percussion

ATLAS COPCO
Bitco Inc.
Black's Machine Shop
BRUNNER & LAY-EASTERN, INC.
Fagersta Steels Inc.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
MOBILE DRILLING INC.
Thompson Products Ltd.
THOR POWER TOOL CO.

### 249 Drill (Rock) Rods, Rotary Large Hole (Quarry & Well)

ACKER DRILL CO., INC.
CHICAGO PNEUMATIC TOOL CO.
DIAMOND DRILL CONTRACTING CO.
Failing, George E., Co.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
MOBILE DRILLING INC.
Reichdrill Div., Chicago Pneumatic Drill Tool
Robbins Machine & Mfg. Co.
Winter Weiss Co.

### 250 Drill (Rock) Rods, Rotary Small Hole

ACKER DRILL CO., INC.
CHICAGO PNEUMATIC TOOL CO.
Failing, George E., Co.
GARDNER DENVER CO.
Guyan Machinery Co.
JOY MFG. CO.
MOBILE DRILLING INC.
Reichdrill Div., Chicago Pneumatic Drill Tool
Stanco Mfg. Corp.

### 251 Drill (Rock) Rod Couplings

ACKER DRILL CO., INC.
Bitco, Inc.
Boyles Bros. Drilling Co., Ltd.
BRUNNER & LAY-EASTERN, INC.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
Guyan Machinery Co.
HOFFMAN BROS. DRILLING CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
MOBILE DRILLING, INC.
Thompson Products Ltd.
SPRAGUE & HENWOOD, INC.

### (Drill Steel—*see* Drill (Rock) Rods

### 252 Drill (Rock) Supports (Columns, Bars, etc.)—*also see* Drill (Rock) Jumbos; Drill (Rock) Booms

ACKER DRILL CO., INC.
Bitco, Inc.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
THOR POWER TOOL CO.

### 253 Drills (Rock & Earth), Auger (Surface Rig)

ACKER DRILL CO., INC.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
Koehring Co.
Long-Airdox Co., Marmon-Herrington Inc.
MOBILE DRILLING INC.
Reichdrill Div., Chicago Pneumatic Drill Tool
Salem Tool Co.

### 254 Drills, Borers & Corers Special Large Diameter Rigs (+12 in.)—*also see* Continuous Miners; does not include Cutting Machines or other drills listed above

ACKER DRILL CO., INC.
MOBILE DRILLING INC.
Reichdrill Div., Chicago Pneumatic Drill Tool
Salem Tool Co.

### 255 DRILLS (Rock), Churn

Bucyrus-Erie Co.
Hillman, C. Kirk, Co., Inc.
Hossfeld Mfg. Co.
MOBILE DRILLING INC.
Spang & Co.

### 256 Drills (Rock) Compressed Air Powered

ACKER DRILL CO., INC.
ATLAS COPCO
Black's Machine Shop
Bucyrus-Erie Co.
CHICAGO PNEUMATIC TOOL CO.
Failing, George E., Co.
GARDNER DENVER CO.
INGERSOLL-RAND CO.
JOY MFG. CO.
LeROY DIV., WESTINGHOUSE AIR BRAKE CO.
Mayhew Machine & Supply Co.
Midwestern Engine & Equipment Co.
MOBILE DRILLING INC.
Schramm Inc.
THOR POWER TOOL CO.
WHEEL TRUEING TOOL CO.

### 257 Drills (Rock), Diamond

ACKER DRILL CO., INC.
American Coldset Corp.
Bico Inc.
Boyles Bros. Drilling Co., Ltd.
CHICAGO PNEUMATIC TOOL CO.
DIAMOND DRILL CONTRACTING CO.
Havlick, J. L.
JOY MFG. CO.
LONGYEAR CO.
McClintock Co.
MOBILE DRILLING INC.
SPRAGUE & HENWOOD INC.
Stanco Mfg. Corp.
WHEEL TRUEING TOOL CO.

### 258 Drills (Rock) Electric Powered

ACKER DRILL CO., INC.
Homelite Corp.
JOY MFG. CO.
MOBILE DRILLING INC.
Penn Machine Co.
Porter-Cable Machine Co.
Reichdrill Div., Chicago Pneumatic Drill Tool
WHEEL TRUEING TOOL CO.

### 259 Drills (Rock) Flame-Jet Piercing

Bucyrus-Erie Co.
Linde Co., Union Carbide Corp.

### 260 DRILLS (Rock) Internal Combustion Engine Powered

ATLAS COPCO
Bucyrus-Erie Co.
Hossfeld Mfg. Co.
JOY MFG. CO.
Long-Airdox Co., Marmon-Herrington Inc.
Mayhew Machine & Supply Co.
Reichdrill Div., Chicago Pneumatic Drill Tool
Stanco Mfg. Corp.
WHEEL TRUEING TOOL CO.
Winter Weiss Co.

### 261 Drills (Rock), Percussion, Large Hole (+4 In.), Quarry & Well

Hillman, C. Kirk, Co., Inc.
INGERSOLL-RAND CO.
JOY MFG. CO.
MISSION MFG. CO.
MOBILE DRILLING INC.
Schramm Inc.
Spang & Co.

### 262 Drills (Rock), Percussion, Large Hole (+4 In.), Quarry & Well, "Down-The-Hole" Type Only

Bucyrus-Erie Co.
CHICAGO PNEUMATIC TOOL CO.
GARDNER DENVER CO.
Hillman, C. Kirk, Co., Inc.
INGERSOLL-RAND CO.
Mayhew Machine & Supply Co.
MOBILE DRILLING INC.
NATIONAL MINE SERVICE CO.
Reichdrill Div., Chicago Pneumatic Drill Tool
Schramm Inc.
Winter Weiss Co.

### 263 Drills (Rock) Percussion, Small Hole (—4 In.) "Down The Hole" Type Only

Bucyrus-Erie Co.
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
Mayhew Machine & Supply Co.
**MOBILE DRILLING INC.**
Reichdrill Div., Chicago Pneumatic Drill Tool
Schramm Inc.

### 264 Drills (Rock), Percussion, Small Hole (—4 In.)

**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO.**
**MISSION MFG. CO.**
**MOBILE DRILLING INC.**
Schramm Inc.
**THOR POWER TOOL CO.**

### 265 Drills (Rock), Rotary Large Hole (+4 In.), Quarry & Well

**ACKER DRILL CO., INC.**
Bucyrus-Erie Co.
**CHICAGO PNEUMATIC TOOL CO.**
Failing, George E., Co.
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Mayhew Machine & Supply Co.
**MOBILE DRILLING INC.**
Reichdrill Div., Chicago Pneumatic Drill Tool
Robbins Machine & Mfg. Co.
Schramm Inc.
Winter Weiss Co.

### 266 Drills (Rock), Rotary, Small Hole (—4 In.)

**ACKER DRILL CO., INC.**
Bucyrus-Erie Co.
**CHICAGO PNEUMATIC TOOL CO.**
Failing, George E., Co.
Fletcher, J. H., & Co.
**GARDNER DENVER CO.**
Hometite Corp.
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Mayhew Machine & Supply Co.
**MOBILE DRILLING INC.**
Reichdrill Div., Chicago Pneumatic Drill Tool
Rogers Iron Works Co.
Schramm, Inc.
Seismograph Service Corp.
**WHEEL TRUEING TOOL CO.**
Winter Weiss Co.

### 267 Drills (Rock), Rotary Percussion, Small Hole (—4 In.)

**CHICAGO PNEUMATIC TOOL CO.**
Fletcher, J. H., & Co.
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**MOBILE DRILLING. INC.**
Reichdrill Div., Chicago Pneumatic Drill Tool
Schramm, Inc.
**THOR POWER TOOL CO.**
Winter Weiss Co.

### 268 Drills (Rock), Self-Contained Power, Pack-Portable Percussion

**ATLAS COPCO**
**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
Hossfeld Mfg. Co.
**JOY MFG. CO.**
Schramm, Inc.

### 269 Drills (Rock), Self-Contained Power, Pack-Portable, Rotary (& Core)

Boyles Bros. Drilling Co., Ltd.
**CHICAGO PNEUMATIC TOOL CO.**
**DIAMOND DRILL CONTRACTING CO.**
Havlick, J. L.
**JOY MFG. CO.**
McClintock Co.
McCulloch Corp., Chain Saw Div.
**MOBILE DRILLING, INC.**
**NEW YORK ENGINEERING CO.**
Packsack Diamond Drills, Ltd.
Rogers Iron Works Co.
Schramm, Inc.
**SPRAGUE & HENWOOD INC.**
Stanco Mfg. Corp.
**WHEEL TRUEING TOOL CO.**

### 270 Drills (Rock & Earth), Water-Jet — does not include Monitors

Carpco Mfg., Inc.
Winter Weiss Co.

### 271 Drives, Belt

**ACME HAMILTON MFG. CORP.**
American Pulley Co.
Bitco, Inc.
Browning Mfg. Co.
Dodge Mfg. Corp.
Flood City Brass & Elec. Co.
**GATES RUBBER CO.**
Lovejoy Flexible Coupling Co.
Morse Chain Co., Borg-Warner Industry
**NATIONAL IRON CO.**
Pickard Industries, Inc., Central Mine Supply Co. Div.
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**WESTERN CONVEYOR CO.**
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

**(Drivers, Mechanical Power Transmission see below, *also see* Clutches; Couplings; Power Take-Offs; Gear Motors)**

### 272 Drives, Chain

Atlas Chain & Mfg. Co.
Bitco, Inc.
Browning Mfg. Co.
Chain Belt Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Dodge Mfg. Corp.
Flood City Brass & Elec. Co.
Foote Bros., Gear & Machine Corp., Whitney Chain Co.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Morse Chain Co., Borg-Warner Industry
Ogden Iron Works Co.
Pickard Industries, Inc., Central Mine Supply Co., Div.
Union Chain & Mfg. Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

### 273 Drives, Fluid

Bitco, Inc.
Dodge Mfg. Corp.
**GENERAL MOTORS CORP., ALLISON DIV.**
**LINK-BELT CO.**
Pickard Industries Inc., Central Mine Supply Co., Div.
Rockwell Mfg. Co.
Rockwell Spring & Axle Co., Timken-Detroit Axle Div.
Twin Disc Clutch Co.

### 274 Drives, Gear

Allis, Louis, Co.
Bitco, Inc.
Blaw-Knox Co.
Brown, David, Inc.
Browning Mfg. Co.
Christian, J. D., Engineers
Cleveland Worm & Gear Division, Eaton Manufacturing Company
Cone-Drive Gears Div., Michigan Tool Co.
Dominion Engineering Co., Ltd.
**FALK CORP.**
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
General Electric Co., Apparatus Sales Div.
General Electric Co., Gear Motor & Transmission Components Dept.
**HEWITT-ROBINS, INC.**
**LINK-BELT CO.**
Lombard Governor Corp.
Metron Instrument Co.
Morse Chain Co., Borg-Warner Industry
Ohio Gear Co.
Reliance Electric & Engineering
Rockwell Spring & Axle Co., Timken-Detroit Axle Div.
Stephens-Adamson Mfg. Co.
U. S. Electrical Motors, Inc.
Wagner Electric Corp.
**WESTERN CONVEYOR CO.**
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**
**WESTINGHOUSE ELECTRIC CORP.**

### 275 Drives, Gear, Shaft-Mounted

American Pulley Co.
Bitco, Inc.
Brown, David, Inc.
Cone-Drive Gears Div., Michigan Tool Co.
Dodge Mfg. Corp.
**FALK CORP.**
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
General Electric Co., Apparatus Sales Div.
General Electric Co., Gear Motor & Transmission Components Dept.
**HEWITT-ROBINS, INC.**
**LINK-BELT CO.**
Lombard Governor Corp.
**NATIONAL IRON CO.**
Ogden Iron Works Co.
Stroh Process Steel Co.
Tool Steel Gear & Pinion Co.
U. S. Electrical Motors, Inc.
Wagner Electric Corp.
**WESTERN CONVEYOR CO.**
**WESTINGHOUSE ELECTRIC CORP.**

### 276 Drives, Magnetic & Eddy-Current

Allis, Louis, Co.
Cutler-Hammer Inc.
General Electric Co., Apparatus Sales Div.
Twin Disc Clutch Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 277 Drives, Variable Speed

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Bitco, Inc.
Browning Mfg. Co.
Century Electric Co.
**CLARK CONTROLLER CO.**
Cleveland Worm & Gear Division, Eaton Manufacturing Company
Cutler-Hammer, Inc.
Dodge Mfg. Corp.
Foote Bros. Gear & Machine Corp., Whitney Chain Co.
General Electric Co., Apparatus Sales Div.
General Electric Co., Gear Motor & Transmission Components Dept.
**HEWITT-ROBINS, INC.**
Hillman, C. Kirk, Co., Inc.
**LINK-BELT CO.**
Lombard Governor Corp.
Lovejoy Flexible Coupling Co.
Marathon Electric Mfg. Corp.
Metron Instrument Co.
Morse Chain Co., Borg-Warner Industry
Oilgear Co.
Reliance Electric & Engineering
Sterling Electric Motors, Inc.
Twin Disc Clutch Co.
U. S. Electrical Motors, Inc.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Vickers, Inc.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**
**WESTINGHOUSE ELECTRIC CORP.**

### 278 Drop Balls (Quarries)

**BALDWIN - LIMA - HAMILTON CORP. STANDARD STEEL WORKS DIV.**
Coeur D'Alenes Co.
Eagle Iron Works
**GEORGIA IRON WORKS CO.**
Sorel Steel Foundries, Ltd.

### 279 Dryers, Rotary, Heated Drum

Baldwin - Lima - Hamilton Corp., Construction Equipment Div.
Blaw-Knox Co.
Bodinson Mfg. Co., Inc.
Denver Equipment Co.
**EIMCO CORP.**
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
**HARDINGE CO., INC.**
Hevi-Duty Electric Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MINE & SMELTER SUPPLY CO.**
**NORDBERG MFG. CO.**
Roberts & Schaefer Co., Div., Thompson-Starrett Co., Inc.

Rockwell, W. S., Co.
**STANDARD STEEL CORP.**
**STEARNS ROGER MFG. CO.**
Universal Dredge Mfg. Co.
**UTAH HYDRO CORP.**

### 280 Dryers, Infra-Red

Booth Co., Inc.
Christian, J. D., Engineers
Corning Glass Works
**HEWITT-ROBINS, INC.**
Jeffrey Mfg. Co.
**MINE & SMELTER SUPPLY CO.**
**UTAH HYDRO CORP.**
**WESTINGHOUSE ELECTRIC CORP.**

### 281 Dryers, Vibrating Pan, Electrically Heated

Hevi-Duty Electric Co.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
**MINE & SMELTER SUPPLY CO.**
**UTAH HYDRO CORP.**

### 282 Dust Collectors & Precipitators—Does not include Classifiers, Cyclone, Dry; Drill (rock) Dust Collectors; Filters, Air; Scrubbers, Air & Waste Gas

Aerotec Industries, Inc.
**AMERICAN AIR FILTER CO., INC.**
American Standard Industrial Div.
**ARMOUR INDUSTRIAL CHEMICAL CO.**
B-I-F Industries, Inc.
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
**BETHLEHEM STEEL CO.**
**BUELL ENGINEERING CO.**
**DIESEL ENERGY CORP.**
**DUCON CO., INC.**
Fuller Co.
**GARDNER DENVER CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Graver Water Conditioning Co., Union Tank Car Co., Div.
**HALLIBURTON OIL WELL CEMENTING**
**JOY MFG. CO.**
Kloeckner-Humboldt-Deutz AG
**MACHINERY CENTER, INC.**
Majac, Inc.
Markley Dust Control System, Inc.
**NORTHERN BLOWER DIV., BUELL ENGINEERING CO., INC.**
Research-Cottrell Inc.
Rockiron Co., Ltd.
Southwestern Engineering Co.
Sly, W. W., Mfg. Co.
Wallace & Tiernan, Inc.
**WESTERN PRECIPITATION DIV., JOY MFG. CO.**
Wheelabrator Corp.

### 283 Dust Samplers

Aerotec Industries, Inc.

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### 284 Electrical Conduit, Raceways & Fittings — *also see Pipe*

Byers, A. M., Co.
Carlon Products Corp.
Chase Brass & Copper Co.
Circle Wire & Cable Corp.
**DRAVO CORP.**
**FLEXAUST CO.**
General Cable Corp.
Ideal Industries, Inc.
**JOHNS-MANVILLE**
Kaiser Aluminum & Chemical Sales
Line Material Industries, McGraw-Edison Co.
National Electric Div., H. K. Porter Co., Inc.
National Supply Co.
**REPUBLIC STEEL CORP.**
Reynolds Metals Co.
Rome Cable Corp., Rome Cable Division of Alcoa
Wadsworth Electric Mfg. Co.
Walker Brothers
**WESTINGHOUSE ELECTRIC CORP.**

### 285 Electric Batteries, Storage, Dry

Bowers Battery & Spark Plug Co.
C & D Batteries, Div. Electric Autolite Co.
Edison, Thomas A. Industries, McGraw-Edison Co., Storage Battery Div.
**ELECTRIC STORAGE BATTERY CO., EXIDE INDUSTRIAL DIV.**
**GOODRICH, B. F., CO., TRUCK & BUS TIRE DEPT.**
**GOULD-NATIONAL BATTERIES, INC.**
Phillips Petroleum Co.
Ray-O-Vac Co.
**U. S. RUBBER CO.**

### 286 Electric Batteries, Storage, Wet

Bowers Battery & Spark Plug Co.
C & D Batteries, Div. Electric Autolite Co.
**ELECTRIC STORAGE BATTERY CO., EXIDE INDUSTRIAL DIV.**
**GOULD-NATIONAL BATTERIES, INC.**
Kersey Mfg. Co., Inc.
Phillips Petroleum Co.
**U. S. RUBBER CO.**

### 287 Electric Battery Chargers

Automatic Switch Co.
C & D Batteries, Div. Electric Autolite Co.
**ELECTRIC STORAGE BATTERY CO., EXIDE INDUSTRIAL DIV.**
**GOODRICH, B. F., CO., TRUCK & BUS TIRE DEPT.**
**GOULD-NATIONAL BATTERIES, INC.**
Guyan Machinery Co.
Hertner Electric Co.
Hobart Bros., Co.
Lincoln Electric Co.
Onan, D. W., & Sons, Inc.

### 288 Electric Battery Transfer Racks

**GOULD-NATIONAL BATTERIES, INC.**

### 289 Electric Cable & Wire—other than below

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
**ANACONDA WIRE & CABLE CO.**
Chester Cable Corp.
Circle Wire & Cable Corp.
Collyer Insulated Wire Co.
Colorado Fuel & Iron Corp.
Continental Wire Co.
Eastman-Pacific Co.
Ettco Wire & Cable Corp.
Flocker, John, & Co.
Flood City Brass & Elec. Co.
General Cable Corp.
Industrial Air Products Co.
Kaiser Aluminum & Chemical Sales
Lincoln Electric Co.
Okonite Co.
**PHELPS DODGE COPPER PRODUCTS**
Pickard Industries, Inc., Central Mine Supply Co., Div.
Revere Corp. of America, Neptune Meter Co.
Reynolds Metals Co.
Rockbestos Wire & Cable Co., Cerro de Pasco Corp.
**ROEBLING'S, JOHN A., SONS, DIV. COLORADO FUEL & IRON CORP.**
Rome Cable Corp., Rome Cable Division of Alcoa
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
Walker Brothers
Western Insulated Wire Co.

### 290 Electric Cable, Armored

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
**ANACONDA WIRE & CABLE CO.**
Chester Cable Corp.
Circle Wire & Cable Corp.
Collyer Insulated Wire Co.
Ettco Wire & Cable Corp.
Flocker, John, & Co.
General Cable Corp.
Kaiser Aluminum & Chemical Sales
Okonite Co.
**PHELPS DODGE COPPER PRODUCTS**
Pickard Industries, Inc., Central Mine Supply Co., Div.
National Electric Div., H. K. Porter Co., Inc.
Revere Corp. of America, Neptune Meter Co.
**ROEBLING'S, JOHN A., SONS, DIV., COLORADO FUEL & IRON CORP.**
Rockbestos Wire & Cable Co., Cerro de Pasco Corp.
Rome Cable Corp., Rome Cable Division of Alcoa
**SIMPLEX WIRE & CABLE CO.**
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**

### 291 Electric Cable, Non Metallic Sheathed

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
**ANACONDA WIRE & CABLE CO.**
Chester Cable Corp.
Circle Wire & Cable Corp.
Ettco Wire & Cable Corp.
Flocker, John, & Co.
General Cable Corp.
Kaiser Aluminum & Chemical Sales
National Electric Div., H. K. Porter Co., Inc.
Okonite Co.
**PHELPS DODGE COPPER PRODUCTS**
Pickard Industries, Inc., Central Mine Supply Co. Div.
Pollyer Insulated Wire Co.
Revere Corp. of America, Neptune Meter Co.
Rockbestos Wire & Cable Co., Cerro de Pasco Corp.
**ROEBLING'S JOHN A., SONS, DIV., COLORADO FUEL & IRON CORP.**
Rome Cable Corp., Rome Cable Division of Alcoa
**SIMPLEX WIRE & CABLE CO.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
Walker Brothers
Western Insulated Wire Co.

### 292 Electric Cable, Trailing

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
**ANACONDA WIRE & CABLE CO.**
Circle Wire & Cable Corp.
Collyer Insulated Wire Co.
Flocker, John, & Co.
Flood City Brass & Elec. Co.
General Cable Corp.
Kaiser Aluminum & Chemical Sales
National Electric Div., H. K. Porter Co., Inc.
National Mine Service Co.
Okonite Co.
**PHELPS DODGE COPPER PRODUCTS**
Pickard Industries Inc., Central Mine Supply Co. Div.
Rockbestos Wire & Cable Co., Cerro de Pasco Corp.
**ROEBLING'S, JOHN A., SONS, DIV., COLORADO FUEL & IRON CORP.**
Rome Cable Corp., Rome Cable Division of Alcoa
**SIMPLEX WIRE & CABLE CO.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
Western Insulated Wire Co.

### 293 Electric Cable Accessories & Fittings

Anaconda Wire & Cable Co.
**G & W ELECTRIC SPECIALTY CO.**
Ideal Industries, Inc.
Industrial Air Products Co.
**JOY MFG. CO.**
National Electric Div., H. K. Porter Co., Inc.
PLM Products, Inc.
Pickard Industries, Inc., Central Mine Supply Co. Div.
Revere Corp. of America, Neptune Meter Co.
Rome Cable Corp., Rome Cable Division of Alcoa
Thomas & Betts Co.
Western Insulated Wire Co.

### 294 Electric Cable Splicers & Vulcanizers

**AMERICAN MINE DOOR CO.**
**AUTOMATIC VULCANIZERS CO.**
Flood City Brass & Elec. Co.
**JOY MFG. CO.**
Minnesota Mining & Mfg. Co.
Pickard Industries Inc., Central Mine Supply Co. Div.

### 295 Electric Converters DC To Ac (does not include Electric Rectifiers)

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
General Electric Co., Apparatus Sales Div.
Hertner Electric Co.
Ideal Electric & Mfg. Co.
Marathon Electric Mfg. Corp.
Onan, D. W., & Sons, Inc.

**WESTINGHOUSE ELECTRIC CORP.**
Wincharger Corp.

### 296 Electric Generators — does not include Electric Generating Power Plants; Electric Converters; Electric Motor - Generator Set; Electric Rectifiers

**ALLIS-CHALMERS MFG. CO., ENGINE-TRIES GROUP**
Allis, Louis, Co.
Electric Machinery Mfg. Co.
**FAIRBANKS, MORSE & CO.**
General Electric Co., Apparatus Sales Div.
Hillman, C. Kirk, Co., Inc.
Ideal Electric & Mfg. Co.
Leland Ohio Electric Co., Howell Electric Motors Co.
Marathon Electric Mfg. Corp.
Onan, D. W., & Sons, Inc.
Sheppard, R. H., & Co., Inc.
**WESTINGHOUSE ELECTRIC CORP.**
Wincharger Corp.

### 297 Electric Generating Power Plants, Mobile & Movable

Alco Products, Inc.
**ALLIS-CHALMERS MFG. CO., ENGINE-MATERIAL HANDLING DIV.**
**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Allis, Louis, Co.
**BROWN BOVERI CORP.**
**CATERPILLAR TRACTOR CO.**
**CHICAGO PNEUMATIC TOOL CO.**
Detroit Diesel Engine Div., General Motors Corp.
**DIESEL ENERGY CORP.**
Electric Machinery Mfg. Co.
Enterprise Engine & Machinery Co.
**FAIRBANKS, MORSE & CO.**
Homelite Corp.
Ideal Electric & Mfg. Co.
Lincoln Electric Co.
Midwestern Engine & Equipment Co.
Miller Electric Mfg. Co.
Murphy Diesel Co.
**NORDBERG MFG. CO.**
Onan, D. W., & Sons, Inc.
Universal Motor Co.
Waukesha Motor Co.
**WESTINGHOUSE ELECTRIC CORP.**
Wincharger Corp.
Witte Engine Works, Oil Well Supply Div., U. S. Steel Corp.

### 298 Electric Generating Power Plants, Stationary

**ALLIS-CHALMERS MFG. CO., ENGINE MATERIAL HANDLING DIV.**
**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
**BROWN BOVERI CORP.**
**CATERPILLAR TRACTOR CO.**
**CHICAGO PNEUMATIC TOOL CO.**
Detroit Diesel Engine Div., General Motors Corp.
**DIESEL ENERGY CORP.**
Enterprise Engine & Machinery Co.
**FAIRBANKS, MORSE & CO.**
Ideal Electric & Mfg. Co.
Murphy Diesel Co.
**NORDBERG MFG. CO.**
Onan, D. W., & Sons, Inc.
**TREADWELL, M. H., CO., INC.**
Universal Motor Co.
**WESTINGHOUSE ELECTRIC CORP.**
Wincharger Corp.
Witte Engine Works, Oil Well Supply Div., U. S. Steel Corp.

### 299 Electric Motor Controls & Starters—*also see* Controls; Electric Motor-Generator Sets; Electric Resistors; Electric Switchgear

Allen-Bradley Co.
**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Bitco, Inc.
**CLARK CONTROLLER CO.**
Cutler-Hammer, Inc.
Durakool, Inc.
Electric Machinery Mfg. Co.
General Electric Co., Apparatus Sales Div.
Guyan Machinery Co.
Hillman, C. Kirk, Co., Inc.
Ideal Electric & Mfg. Co.
**NATIONAL MINE SERVICE CO.**
OPW-Jordan Corp.
**OHIO BRASS CO.**
Ready Power Co.
Reliance Electric & Engineering
Wagner Electric Corp.
**WESTINGHOUSE ELECTRIC CORP.**

### 300 Electric-Motor Generator Sets—does not include Electric Converters; Electric Rectifiers

AGA Corp. of America
Alco Products, Inc.
**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Allis, Louis, Co.
**ASEA ELECTRIC, INC.**
C & D Batteries, Div. Electric Autolite Co.
Century Electric Co.
**CHICAGO PNEUMATIC TOOL CO.**
Electric Machinery Mfg. Co.
General Electric Co., Apparatus Sales Div.
Geodimeter Co.
Hertner Electric Co.
Hillman, C. Kirk, Co., Inc.
Ideal Electric & Mfg. Co.
Ironton Engine Co.
Kersey Mfg. Co., Inc.
Leland Ohio Electric Co., Howell Electric Motors Co.
Marathon Electric Mfg. Corp.
Marble Electric Corp.
Ready Power Co.
Reliance Electric & Engineering
**THOR POWER TOOL CO.**
**WESTINGHOUSE ELECTRIC CORP.**

### 301 Electric Motors — does not include Gear Motors

**ALLIS-CHALMERS MFG., CO., INDUS-TRIES GROUP**
Allis, Louis, Co.
**ASEA ELECTRIC, INC.**
Bitco, Inc.
**BROWN BOVERI CORP.**
Century Electric Co.
Electric Machinery Mfg. Co.
**FAIRBANKS, MORSE & CO.**
General Electric Co., Apparatus Sales Div.
Hertner Electric Co.
Hillman, C. Kirk, Co., Inc.
Howel Electric Motors Co.
Ideal Electric & Mfg. Co.
Kersey Mfg. Co., Inc.
Leland Ohio Electric Co., Howell Electric Motors Co.
Lincoln Electric Co.
Marathon Electric Mfg. Corp.
Marble Electric Corp.
Reliance Electric & Engineering
Robbins & Myers, Inc.
Sterling Electric Motors, Inc.
U. S. Electrical Motors, Inc.
**WESTINGHOUSE ELECTRIC CORP.**
Wincharger Corp.

### 302 Electric Motors, Protected

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Allis, Louis, Co.
Bitco, Inc.
**BROWN BOVERI CORP.**
Century Electric Co.
Electric Machinery Mfg. Co.
**FAIRBANKS, MORSE & CO.**
General Electric Co., Apparatus Sales Div.
Howel Electric Motors Co.
Ideal Electric & Mfg. Co.
Leland Ohio Electric Co., Howell Electric Motors Co.
Marathon Electric Mfg. Corp.
Marble Electric Corp.
Reliance Electric & Engineering
Robbins & Myers, Inc.
U. S. Electrical Motors, Inc.
**WESTINGHOUSE ELECTRIC CORP.**

### 303 Electric Rectifiers, Mechanical

C & D Batteries, Div. Electric Autolite Co.
**BROWN BOVERI CORP.**

### 304 Electric Rectifiers, Mercury Arc

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
**BROWN BOVERI CORP.**
General Electric Co., Apparatus Sales Div.
**WESTINGHOUSE ELECTRIC CORP.**

### 305 Electric Rectifiers Motor —Generator Sets

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Allis, Louis, Co.
**BROWN BOVERI CORP.**
C & D Batteries, Div. Electric Autolite Co.
General Electric Co., Apparatus Sales Div.
Hillman, C. Kirk, Co., Inc.
Industrial Air Products Co.
Reliance Electric & Engineering

### 306 Electric Rectifiers Selenium & Rare Metal

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
C & D Batteries, Div. Electric Autolite Co.
General Electric Co., Apparatus Sales Div.
International Rectifier Corp.
Ionics, Inc.
Kersey Mfg. Co., Inc.
Miller Electric Mfg. Co.
Perkin Engineering Corp.
**WESTINGHOUSE ELECTRIC CORP.**

### 307 Electric Rectifiers, Synchronous Converter

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
General Electric Co., Apparatus Sales Div.
Hillman, C. Kirk, Co., Inc.
Reliance Electric & Engineering
**WESTINGHOUSE ELECTRIC CORP.**

### 308 Electric Rectifiers, Vacuum Tube (Electronic)

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
Carpco Mfg. Inc.
General Electric Co., Apparatus Sales Div.
Ionics Inc.
**WESTINGHOUSE ELECTRIC CORP**

### 309 Electric Rectifiers, Special or Other Than Above

C & D Batteries, Div. Electric Autolite Co.
Ionics, Inc.
International Rectifier Corp.
Perkin Engineering Corp.
**WESTINGHOUSE ELECTRIC CORP.**

### 310 Electric Resistors & Rheostats

Allen-Bradley Co.
**CLARK CONTROLLER CO.**
Cutler-Hammer, Inc.
Guyan Machinery Co.
General Electric Co., Apparatus Sales Div.
Hillman, C. Kirk, Co., Inc.
**WESTINGHOUSE ELECTRIC CORP.**

### 311 Electric Switch-Gear & Switches—*Also see* Electrical brushes; Controls, Electrical; Meters, Electrical; Electric Trolley Accessories

Allen-Bradley Co.
**ALLIS-CHALMERS MFG. CO., INDUS-DUSTRIES GROUP**
Bitco, Inc.
**BROWN BOVERI CORP.**
**CLARK CONTROLLER CO.**
Cutler-Hammer, Inc.
Durakool, Inc.
Electric Machinery Mfg. Co.
**G & W ELECTRIC SPECIALTY CO.**
General Electric Co., Apparatus Sales Div.
Ideal Electric & Mfg. Co.
Line Material Industries, McGraw-Edison Co.
**OHIO BRASS CO.**
Ohio Carbon Co.
Revere Corp. of America, Neptune Meter Co.
Wadsworth Electric Mfg. Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 312 Electric Transformers — *also see* Unit Substations below

**ALLIS-CHALMERS MFG. CO., INDUS-TRIES GROUP**
**ASEA ELECTRIC, INC.**
**BROWN BOVERI CORP.**
Durakool, Inc.

General Electric Co., Apparatus Sales Div.
Kuhlman Electric Co.
Line Material Industries, McGraw-Edison Co.
Moloney Electric Co.
Wagner Electric Corp.
**WESTINGHOUSE ELECTRIC CORP.**

### 313 Electric Trolley Accessories

**CHEATHAM ELECTRIC SWITCHING DEVICE CO.**
Flood City Brass & Elec. Co.
Manning, Maxwell & Moore, Inc. Shaw Box Crane & Hoist Div.
**NACHOD & U.S. SIGNAL CO.**
**OHIO BRASS CO.**
Shepard Niles Crane & Hoist Corp.

### 314 Electric Unit Sub-Stations

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Dresser-Ideco Co.
General Electric Co., Apparatus Sales Div.
Moloney Electric Co.
Wagner Electric Corp.
**WESTINGHOUSE ELECTRIC CORP.**

### 315 Electric Voltage Regulators

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**CLARK CONTROLLER CO.**
General Electric Co., Apparatus Sales Div.
International Rectifier Corp.
Line Material Industries, McGraw-Edison Co.
Moloney Electric Co.
Reliance Electric & Engineering
Southwestern Industrial Electronics Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 316 Electrolytic Cells & Process Equipment (Special)

Ionics, Inc.
**TREADWELL, M. H., Co., Inc.**

### 317 Elevators, Plant Buildings (Man & Material) —does not include Conveyors; Hoists (Mine)

**CONNELLSVILLE MFG. & MINE SUPPLY**
Stephens-Adamson Mfg. Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 318 Engine Filters, Oil

**CATERPILLAR TRACTOR CO.**
Cochrane Corp.
Fram Corp.
Midwestern Engine & Equipment Co.
Purolator Products, Inc.
Sharples Corp.

### (Engine Accessories—see below and Drives)

### 319 Engines, Diesel

Alco Products, Inc.
**ALLIS-CHALMERS MFG. CO., ENGINE-MATERIAL HANDLING DIV**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**CATERPILLAR TRACTOR CO.**
**CHICAGO PNEUMATIC TOOL CO.**
**CUMMINS ENGINE CO., INC.**
**DEERE & CO.**
Detroit Diesel Engine Div., General Motors Corp.
**DIESEL ENERGY CORP.**
Dominion Engineering Co., Ltd.
Enterprise Engine & Machinery Co.
**FAIRBANKS, MORSE & CO.**
**HARNISCHFEGER CORP.**
Hercules Motors Co.
Kloeckner-Humboldt-Deutz AG
Lister-Blackstone, Inc.
**MACHINERY CENTER, INC.**
Midwestern Engine & Equipment Co.
Murphy Diesel Co.
**NORDBERG MFG. CO.**
Oliver Corp.
Page Engineering Co.
Sheppard, R. H., & Co., Inc.
Waukesha Motor Co.
Witte Engine Works, Oil Well Supply Div., U. S. Steel Corp.

### 320 Engines, Gas & Gasoline

**ALLIS-CHALMERS MFG. CO., ENGINE MATERIAL HANDLING DIV**
**ALLIS-CHALMERS MFG. Co., INDUSTRIES GROUP**
Briggs & Stratton Corp.
**CHICAGO PNEUMATIC TOOL CO.**
**DEERE & CO.**
**DIESEL ENERGY CORP.**
Enterprise Engine & Machinery Co.
**FAIRBANKS, MORSE & CO.**
Ford Motor Co.
Hercules Motors Co.
Kloeckner-Humboldt-Deutz AG
**NORDBERG MFG. CO.**
Midwetern Engine & Equipment Co.
Oliver Corp.
Onan, D. W., & Sons, Inc.
Waukesha Motor Co.
Wisconsin Motor Corp.
Witte Engine Works, Oil Well Supply Div., U. S. Steel Corp.

### 321 Engines, Hydraulic Turbine

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Davis Foundry & Machine Works

### 322 Engines, Steam

**COPPUS ENGINEERING CO.**
Dean Hill Corp.

### 323 Engine Exhaust Scrubbers

Oxy-Catalyst, Inc.

### 324 Excavators, Bucketline

**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Gar Wood Industries, Inc.
Midwestern Engine & Equipment Co.

### 325 Excavators, Bucket Wheel

Bucyrus-Erie Co.
Gar Wood Industries, Inc.
**HARNISCHFEGER CORP.**
**LINK-BELT CO.**
Midwestern Engine & Equipment Co.

### 326 Excavators Clam Shell & Grab Crane

**AMERICAN HOIST & DERRICK CO.**
Baldwin - Lima - Hamilton Corp., Construction Equipment Div.
Bucyrus-Erie Co.
**CLARK EQUIPMENT CO., CONSTUCTION MACHINERY DIV.**
Dominion Engineering Co., Ltd.
Gar Wood Industries, Inc.
Hyster Co.
Koehring Co.
**LINK-BELT SPEEDER CORP.**
**MACHINERY CENTER, INC.**
**MANITOWOC ENGINEERING CORP.**
**MARION POWER SHOVEL CO., UNIVERSAL MARION CORP.**
Midwestern Engine & Equipment Co.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Schield Bantam Co.
Thew Shovel Co.
Unit Crane & Shovel Corp.
Washington Iron Works

### 327 Excavators, Dipper Shovel

**AMERICAN HOIST & DERRICK CO.**
Baldwin-Lima-Hamilton Corp., Construction Equipment Div.
Bucyrus-Erie Co.
Dominion Engineering Co., Ltd.
Gar Wood Industries, Inc.
**HARNISCHFEGER CORP.**
Hyster Co.
Koehring Co.
**LINK-BELT SPEEDER CORP.**
**MANITOWOC ENGINEERING CORP.**
**MARION POWER SHOVEL CO., UNIVERSAL MARION CORP.**
Midwestern Engine & Equipment Co.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Quick-Way Truck Shovel Co.
Schield Bantam Co.
Thew Shovel Co.
Unit Crane & Shovel Corp.

### 328 Excavators, Drag - Line Crane

**AMERICAN HOIST & DERRICK CO.**
Baldwin-Lima-Hamilton Corp., Construction Equipment Div.
Bucyrus-Erie Co.
Dominion Engineering Co., Ltd.
Gar Wood Industries, Inc.
**HARNISCHFEGER CORP.**
Hyster Co.
Koehring Co.
**LINK-BELT SPEEDER CORP.**
**MANITOWOC ENGINEERING CORP.**
**MARION SHOVEL CO., UNIVERSAL MARION CORP.**
Midwestern Engine & Equipment Co.
Northwest Engineering Co.
Orton Crane & Shovel Co.
Page Engineering Co.
Quick-Way Truck Shovel Co.
Schield Bantam Co.
Thew Shovel Co.
Unit Crane & Shovel Corp.
Washington Iron Works

### 329 Excavator, Drag - Line Tower

**SAUERMAN BROS., INC.**
Washington Iron Works

### (Exploration Equipment — see Surveying Equipment; Food, Packaged Kits; Tarpaulins; Geologist's Equip.; Transits, Pocket)

### (Explosives — see Blasting Compounds)

### (Exploration Services, Aerial —see Contractors)

# F

### 330 Fans & Blowers, Air & Gas

Aerotec Industries, Inc.
**AMERICAN AIR FILTER CO., INC.**
**AMERICAN MACHINE & METALS, INC., DE BOTHEZAT FANS DIV.**
American Standard Industrial Div.
**BROWN BOVERI CORP.**
Buffalo Forge Co.
Campbell, E. K., Co.
Clarage Fan Co.
Clipper Belt Lacer Co.
**COPPUS ENGINEERING CO.**
Diehl Mfg. Co.
Duriron Co., Inc.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Guyan Machinery Co.
Hartzell Propeller Fan Co.
Hauck Mfg. Co., Equipment Div.
Hillman, C. Kirk, Co., Inc.
Jeffrey Mfg. Co.
**JOY MFG. CO.**
Kloeckner-Humboldt-Deutz AG
Lehigh Fan Div., Fuller Co.
**MACHINERY CENTER, INC.**
Moore Co.
**NORTHERN BLOWER DIV., BUELL ENGINEERING CO., INC.**
Robbins & Myers, Inc.
Robinson Ventilating Co.
Rockiron Co., Ltd.
Roots-Connersville Blower Div., Dresser Industries, Inc.
Sutorbilt Corp., Fuller Co.
U. S. Hoffman Machinery Corp., Air Appliance Div.
**WESTINGHOUSE ELECTRIC CORP.**
**WESTINGHOUSE ELECTRIC CORP. STURTEVANT DIV.**

### 331 Fasteners — Screws, Bolts, Nails, Spikes, Nuts, Washers, etc.— does not include Rock and Roof Bolts; Timber Connectors

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
Ampco Metal, Inc.

**ATLAS CAR & MFG. CO.**
**BETHLEHEM STEEL CO.**
Chase Brass & Copper Co.
Colorado Fuel & Iron Corp.
Commercial Shearing & Stamping Co.
Elastic Stop Nut Corp. of America
Foster, L. B., Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Lamson & Sessions Co.
Metal Goods Corp.
National Lock Washer Co.
Palnut Co., United-Carr Fastener Corp.
Remington Arms Co., Inc.
**REPUBLIC STEEL CORP.**
Screw & Bolt Corp. of America
Sheffield Div., Armco Steel Corp.

### 332 Feeders, Chain (Ross Type)

Columbus McKinnon Chain Corp., Mining Equipment Div.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Denver Equipment Co.
**DIESEL ENERGY CORP.**
Industrial Engineering & Construction Co.
**LINK-BELT CO.**
**NATIONAL IRON CO.**
**ROSS SCREEN & FEEDER CO.**
Smith Engineering Works

### 333 Feeders, Constant Weight & Weighing — *also see* Scales

B-I-F Industries, Inc.
**HARDINGE CO., INC.**
**INDUSTRIAL PHYSICS & ELECTRONICS**
Infilco, Inc.
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
McDowell Co., Inc., Wellman Engineering Co.
**MERRICK SCALE MFG. CO.**
**MORSE BROS. MACHINERY CO.**
Schaffer Poidometer Co.
Stephens-Adamson Mfg. Co.
Thayer Scale
Trans-Weigh Corp.
Wallace & Tiernan, Inc.

### 334 Feeders, Reagent, Dry

B-I-F Industries, Inc.
Coeur D'Alenes Co.
Denver Equipment Co.
**EIMCO CORP.**
Engelhard Industries, Inc.
**ERIEZ MFG. CO.**
Infilco, Inc.
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Permutit Co. Div., Pfaudler Permutit, Inc.
Wallace & Tiernan, Inc.

### 335 Feeders, Reagent, Liquid

B-I-F Industries Inc.
Clarkson Co.
Denver Equipment Co.
**EIMCO CORP.**
Galigher Co.
**INDUSTRIAL PHYSICS & ELECTRONICS**
Infilco Inc.
Kloeckner-Humboldt-Deutz AG
**MACHINERY CENTER INC.**
**MINE & SMELTER SUPPLY CO.**
**MORSE BROS. MACHINERY CO.**
Permutit Co. Div., Pfaudler Permutit Inc.
Wallace & Tiernan Inc.

### 336 Feeders, Reciprocating Plunger

B-I-F Industries Inc.
**BALDWIN - LIMA - HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV.**
Bodinson Mfg. Co., Inc.
Christian, J. D., Engineers
Columbus Conveyor Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Denver Equipment Co.
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
**IOWA MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
**McLANAHAN & STONE CORP.**
**McNALLY PITTSBURG MFG. CORP.**
**NATIONAL IRON CO.**
Rogers Iron Works Co.
Smith Engineering Works
Universal Dredge Mfg. Co.
Wallace & Tiernan Inc.

### 337 Feeders, Revolving Disk & Plate

B-I-F Industries Inc.
Bonded Scale & Machine Co.
Carpco Mfg. Inc.
Chain Belt Co.
Christian, J. D., Engineers
Dagley Mfg. Co.
Denver Equipment Co.
**HARDINGE CO. INC.**
**HEWITT-ROBINS INC.**
Industrial Engineering & Construction Co.
**IOWA MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works Inc.
Pulva Corp.
Rogers Iron Works Co.
Smith Engineering Works

### 338 Feeders, Rotary, Drum

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Chain Belt Co.
Christian, J. D., Engineers
**DEISTER CONCENTRATOR CO.**
Engineered Equipment Inc.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HARDINGE CO. INC.**
**LINK-BELT CO.**
Pulva Corp.
Wagner Electric Corp.

### 339 Feeders, Rotary, Vane

B-I-F Industries, Inc.
Chain Belt Co.
Christian, J. D., Engineers
Cour D'Alenes Co.
Davis Foundry & Machine Works
Engineered Equipment, Inc.
Fairmont Machinery Co.
Fuller Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**LINK-BELT CO.**
Pulva Corp.
Richardson Scale Co.
Stephens-Adamson Mfg. Co.
Universal Dredge Mfg. Co.
Wagner Electric Corp.

### 340 Feeders, Vibrating, Shaking, etc. (Plate, Table, etc.)—does not include Grizzlies or Screens

Ajax Flexible Coupling Co.
B-I-F Industries, Inc.
Chain Belt Co.
Christian, J. D., Engineers
Cleveland Vibrator Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Diamond Iron Works Div., Goodman Mfg. Co.
**ERIEZ MFG. CO.**
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
**HAMMERMILLS INC.**
**HEWITT-ROBINS, INC.**
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Ridge Equipment Co.
Simplicity Engineering Co.
Smith Engineering Works
Southwestern Engineering Co.
Stephens-Adamson Mfg. Co.
Stop-Fire, Inc.
**STRAUBE MFG. CO.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN CONVEYOR CO.**

### 341 Fencing, Metal Wire

American Chain & Cable Co., Page Steel & Wire Div.
**BETHLEHEM STEEL CO.**
Colorado Fuel & Iron Corp.
**REPUBLIC STEEL CORP.**
Sheffield Div., Armco Steel Corp.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 342 Filter Bags

Albany Felt Co.
**AMERICAN AIR FILTER CO., INC.**
**BEMIS BROS. BAG CO.**
Coast Mfg. & Supply Co.
Daniels, C. R., Inc.
**EIMCO CORP.**
Filtration Engineers Div., American Machine & Metals, Inc.
Fram Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Koppers Co., Inc., Metal Prod. Div.
**NATIONAL FILTER MEDIA CORP.**
**NORTHERN BLOWER DIV., BUELL ENGINEERING CO., INC.**
Pendleton Woolen Mills
**PETERSON FILTERS & ENGINEERING CO.**
Sly, W. W., Mfg. Co.
U. S. Hoffman Machinery Corp., Air Appliance Div.
Wheelabrator Corp.

### 343 Filter Cloth

Albany Felt Co.
**BEMIS BROS. BAG CO.**
Cambridge Wire Cloth Co.
Daniels, C. R., Inc.
**EIMCO CORP.**
Filtration Engineers Div., American Machine & Metals, Inc.
Multi-Metal Wire Cloth Co., Inc.
**NATIONAL FILTER MEDIA CORP.**
National Standard Co.
Newark Wire Cloth Co.
Pendleton Woolen Mills
**PETERSON FILTERS & ENGINEERING CO.**
Southwestern Engineering Co.
Star Wire Screen & Iron Works, Inc.
**TYLER, W. S., CO.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Wellington Sears Co.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 344 Filter Media (other than Bags & Cloth)

**AMERICAN AIR FILTER CO., INC.**
Eagle-Picher Co.
Filtration Engineers Div., American Machine & Metals, Inc.
**JOHNS-MANVILLE**
**NATIONAL FILTER MEDIA CORP.**
Norton Co.
Permutit Co. Div., Pfaudler Permutit, Inc.
**PETERSON FILTERS & ENGINEERING CO.**
Purolator Products, Inc.

### (Filters—see below and Engine Filters)

### 345 Filters, Air, Gas & Dust

**AMERICAN AIR FILTER CO., INC.**
Carrier Corp.
**CHICAGO PNEUMATIC TOOL CO.**
Coast Mfg. & Supply Co.
**COPPUS ENGINEERING CO.**
**DIESEL ENERGY CORP.**
**DUCON CO., INC.**
Farr Co.
Fram Corp.
Fuller Co.
**GARDNER DENVER CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Johnson Corp.
Kloeckner-Humboldt-Deutz AG
Koppers Co., Inc., Metal Prod. Div.
Multi-Metal Wire Cloth Co., Inc.
Parker-Hannifin Corp.
Purolator Products, Inc.
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**
**WESTERN PRECIPITATION DIV.**
Wheelabrator Corp.
Wilkerson Corp.

### 346 Filters (Process), Air, Gas & Dust

Carrier Corp.
Coast Mfg. & Supply Co.
Duriron Co., Inc.
Farr Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Kloeckner-Humboldt-Deutz AG
Multi-Metal Wire Cloth Co., Inc.
Purolator Products, Inc.
Wheelabrator Corp.

### 347 Filters, Concentrate

Denver Equipment Co.
Duriron Co., Inc.
**EIMCO CORP.**
Filtration Engineers Div., American Machine & Metals, Inc.
Galigher Co.
**HARDINGE CO., INC.**

Kloeckner-Humboldt-Deutz AG
**MORSE BROS. MACHINERY CO.**
Multi-Metal Wire Cloth Co., Inc.
**PETERSON FILTERS & ENGINEERING CO.**

**(Filters, Engine Oil—*see* Engine Filters)**

### 348 Filters, Water & Liquid

B-I-F Industries, Inc.
**BETHLEHEM STEEL CO.**
Bird Machine Co.
Cochrane Corp.
Corning Glass Works
Duriron Co., Inc.
Eastern Steel Plate Fabricators, Inc.
**EIMCO CORP.**
Fram Corp.
Graver Water Conditioning Co., Union Tank Car Co. Div.
**HARDINGE CO., INC.**
Infilco, Inc.
Kloeckner-Humboldt-Deutz AG
**MINE & SMELTER SUPPLY CO.**
Multi-Metal Wire Cloth Co., Inc.
Permutit Co. Div., Pfaudler Permutit, Inc.
**PETERSON FILTERS & ENGINEERING CO.**
Purolator Products, Inc.
Stein, Hall & Co., Inc.
Wilkerson Corp.

### 349 Fire Fighting Equipment & Supplies

Ansul Chemical Co.
Bullard, E. D., Co.
Cutler-Hammer, Inc.
Daniels, C. R., Inc.
Elkhart Brass Mfg. Co., Inc.
FWD Corp.
Fyr-Fyter Co.
Grinnell Co., Inc.
Guyan Machinery Co.
Kidde & Co., Inc.
Megator Corp.
**MINE SAFETY APPLIANCES CO.**
Rice Pump & Machine Co.

### 350 First Aid Equipment & Supplies

Bullard, E. D., Co.
Fyr-Fyter Co.
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
Safety First Supply Co.

### 351 Flocculating Reagents—*also see* Water Clarification Chemicals

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
**ARMOUR INDUSTRIAL CHEMICAL CO.**
Burtonite Co.
Dow Chemical Co.
**EIMCO CORP.**
Fisher Scientific Co.
**LINK-BELT CO.**
Nalco Chemical Co.
Pennsalt Chemicals Corp.
Permutit Co. Div., Pfaudler Permutit, Inc.
Rohm & Haas Co.
Stein, Hall & Co., Inc.
Tennessee Corp.

### 352 Flood Lights, Carbide

Linde Co., Union Carbide Corp.

### 353 Flood Lights, Electric—*also see* Lighting Fixtures & Lamps

General Electric Co., Apparatus Sales Div.
**MINE SAFETY APPLIANCES CO.**
Phoenix Products Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 354 Flotation Machines

Booth Co., Inc.
Cannon Concentrator
Dagley Mfg. Co.
**DIESEL ENERGY CORP.**
Denver Equipment Co.
Galigher Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Graver Water Conditioning Co., Union Tank Car Co. Div.
Infilco, Inc.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MACHINERY CENTER, INC.**
**MORSE BROS. MACHINERY CO.**
Permutit Co. Div., Pfaudler Permutit, Inc.
Roberts & Schaefer Co. Div., Thompson-Starrett Co., Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 355 Flotation Reagents

**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT.**
**AMERICAN POTASH & CHEMICAL CO.**
Arizona Chemical Co.
**ARMOUR INDUSTRIAL CHEMICAL CO.**
**BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP.**
Burtonite Co.
Dow Chemical Co.
Emery Industries, Inc.
Fisher Scientific Co.
Food Machinery & Chemical Corp., Mineral Products Div., Chlor-Alkali Div.
Marathon Div. American Can Co.
Newport Industries Co., Heyden Newport Chemical Corp.
Onyx Chemical Corp.
Pacific Lumber Co.
Pennsalt Chemicals Corp.
Permutit Co. Div., Pfaudler Permutit, Inc.
**PHILADELPHIA QUARTZ CO.**
Tennessee Corp.

### 356 Food, Packaged Kits

Bolton Farm Packing Co.

### 357 Forges, Blacksmith, etc.

ACF Industries, Inc., American Car & Foundry Div.
Buffalo Forge Co.
Spang & Co.

### 358 Forgings, Drop, Et Al

ACF Industries, Inc., American Car & Foundry Div.
Alco Products, Inc.
American Brake Shoe Co.
American Steel Foundries
**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
**BETHLEHEM STEEL CO.**
Chase Brass & Copper Co.
Commercial Shearing & Stamping Co.
**EIMCO CORP.**
Endicott Forging & Mfg. Co.
Ladish Co.
Pettibone Mulliken Corp.
Revere Copper & Brass, Inc.
Rockiron Co., Ltd.

### 359 Freezeproofing Materials—does not inclue Concrete Additives

Dow Chemical Co.
Wyandotte Chemicals Corp., Michigan Alkali Div.

### 360 Furnaces, Industrial Process, Combustion Heated (Heating, Melting, Roasting, Smelting, Ceramic, Metallurgical, Refractory, etc.)—does not include Boilers; Burners; Dryers; Heaters; Laboratory Equipment; Retorts; Sintering Equipment; *also see* below and Kilns; Converters.

Bigelow-Liptak Corp.
Denver Fire Clay Co.
**DORR OLIVER, INC.**
Engelhard Industries, Inc.
**GOULD, GORDON I., CO.**
Hevi-Duty Electric Co.
**MINE & SMELTER SUPPLY CO.**
Rockwell, W. S., Co.
Sly, W. W., Mfg. Co.
**STANNDARD STEEL CORP.**
Surface Combustion Div., Midland-Ross Corp.

### 361 Furnaces, Industrial Process, Electric Heated (Heating, Melting, Roasting, Smelting, Ceramic, Metallurgical, Refractory, etc.)—does not include Boilers; Burners; Dryers; Heaters; Laboratory Equipment; Retorts; Sintering Equipment; *also see below* and Kilns, Converters

American Bridge Div., U. S. Steel Corp.
**ASEA ELECTRIC, INC.**
**BROWN BOVERI CORP.**
**DIESEL ENERGY CORP.**
**ELEKTROKEMISK A. S.**
General Electric Co., Apparatus Sales Div.
Hevi-Duty Electric Co.
Kuhlman Electric Co.
Lectromelt Furnace Div., McGraw Edison Co.
Rockwell, W. S., Co.
Sly, W. W., Mfg. Co.
**U. S. STEEL CORP.**
Whiting Corp.

### 362 Furnaces, Industrial process, Fluidized Solids

Bitco, Inc.
**DIESEL ENERGY CORP.**
**DORR OLIVER, INC.**
Ionics, Inc.
**STANDARD STEEL CORP.**
Surface Combustion Div., Midland-Ross Corp.

### 363 Furnaces, Industrial Process, Shaft (Blast Cupola, etc.)

**DIESEL ENERGY CORP.**
Kloeckner-Humboldt-Deutz AG
Surface Combustion Div., Midland-Ross Corp.
Whiting Corp.

### 364 Furnaces, Industrial Process, Stationary Hearth & Reverberatory

Denver Fire Clay Co.
Hevi-Duty Electric Co.
Rockwell, W. S., Co.
Surface Combustion Div., Midland-Ross Corp.

### 365 Furnaces, Shop & Bench (Heat Treating, Melting, Forging, etc.)—*also see* Drill (Rock) Bit & Steel Forging & Heat Treating Furnaces; Forges; does not include Laboratory Equipment

Bitco, Inc.
Denver Fire Clay Co.
Hevi-Duty Electric Co.
Leeds & Northrup Co.
Rockwell, W. S., Co.
Surface Combustion Div., Midland-Ross Corp.

### 366 Furnaces, Smelting & Roasting

**GOULD, GORDON I., CO.**
Kloeckner-Humboldt-Deutz AG
**MINE & SMELTER SUPPLY CO.**
**TREADWELL, M. H., CO., INC.**

**(Furnace Burners—*see* Burners)**

### 368 Furnace Linings, Wall & Arches—*also see* Refractories

**BABCOCK & WILCOX CO.**
Bigelow-Liptak Corp.
Cement Gun Co.
Denver Fire Clay Co.
Gladding, McBean & Co.
Green Fire Brick Co.
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc.
National Carbon Co., Union Carbide Corp.
Norton Co.
Pittsburgh Corning Corp.
Robinson Clay Product Co.
Walsh Refractories Corp.

# G

(Gages—see Meters)

(Galvanometers—see Meters Electricity)

### 369 Gases, Industrial (Oxygen, Hydrogen, Carbon Dioxide, Acetylene, etc.)

**ARMOUR INDUSTRIAL CHEMICAL CO.**
Industrial Air Products Co.
Linde Co., Union Carbide Corp.
**STANDARD OIL CO. OF CALIFORNIA, WESTERN OPERATIONS, INC.**

### 370 Gas (& Humidity) Detectors & Indicators—*Also see* Meters, Chemical

Bristol Co.
Engelhard Industries, Inc.
General Electric Co., Apparatus Sales Div.
**NATIONAL MINE SERVICE CO.**

### 371 Gas Generators

Cryogenerators, Inc.
Hevi-Duty Electric Co.
Kloeckner-Humboldt-Deutz AG
McDowell Co., Inc., Wellman Engineering Co.
Rexarc, Inc., Sight Feed Generator Co.
Surface Combustion Div., Midland-Ross Corp.
Vuclan-Cincinnati, Inc.

### 372 Gas Separation Process Equipment (Special) — does not include Dust Collectors or standard auxiliary equipment

Aerotec Industries, Inc.
Vulcan-Cincinnati, Inc.

### 373 Gaskets

Akron Metallic Gasket Co.
Continental Rubber Works
Garlock, Inc.
Goodall Rubber Co.
**GOODYEAR TIRE & RUBBER CO.**
Greene, Tweed & Co.
**HEWITT-ROBINS, INC.**
**JOHNS-MANVILLE**
Parker-Hannifin Corp.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Thermoid Div., H. K. Porter Co., Inc.
**VICTAULIC CO. OF AMERICA**

### 374 Gear Motors—*also see* Drives; Electric Motors

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Allis, Louis, Co.
Bitco, Inc.
Brown, David, Inc.
Century Electric Co.
Christian, J. D., Engineers
Commercial Shearing & Stamping Co.
Cone-Drive Gears Div., Michigan Tool Co.
**EIMCO CORP.**
**FAIRBANKS, MORSE & CO.**
**FALK CORP.**
General Electric Co., Apparatus Sales Div.
General Electric Co., Gear Motor & Transmission Components Dept.
**HEWITT-ROBINS, INC.**
Howell Electric Motors Co.
**LINK-BELT CO.**
Morse Chain Co., Borg-Warner Industry
Philadelphia Gear Corp.
Reliance Electric & Engineering
Sterling Electric Motors, Inc.
U. S. Electrical Motors, Inc.
Wagner Electric Corp.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**
**WESTINGHOUSE ELECTRIC CORP.**

(Gear Pullers—see Car Wheel & Gear Pullers)

### 375 Gears & Pinions, Metal *also see below*

**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Atlas Steel Casting Co.
**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
**BIRDSBORO CORP.**
Bitco, Inc.
Blaw-Knox Co.
Brown, David, Inc.
Cone-Drive Gears Div., Michigan Tool Co.
Davis Foundry & Machine Works
Dominion Engineering Co., Ltd.
**FALK CORP.**
General Electric Co., Gear Motor Transmission Components Dept.
**HEWITT-ROBINS, INC.**
Illinois Gear & Machine Co.
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Meehanite Corp.
Morse Chain Co., Borg-Warner Industry
North American Gear Co.
Olds Alloy Co.
Penn Machine Co.
Philadelphia Gear Corp.
Pittsburgh Gear Co.
Stahl Gear & Machine Co.
**STEARNS ROGER MFG. CO.**
Stroh Process Steel Co.
Tool Steel Gear & Pinion Co.
Union Chain & Mfg. Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

### 376 Gears & Pinions, Metal Large (Ball-Mill, Mine Shaft Hoist, et al)

**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
Bitco, Inc.
Brown, David, Inc.
Dominion Engineering Co., Ltd.
**FALK CORP.**
Guyan Machinery Co.
**HEWITT-ROBINS, INC.**
Illinois Gear & Machine Co.
Meehanite Corp.
Ohio Gear Co.
Penn Machine Co.
Philadelphia Gear Corp.
Pittsburgh Gear Co.
Stahl Gear & Machine Co.
**STEARNS ROGER MFG. CO.**
Stroh Process Steel Co.
Tool Steel Gear & Pinion Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

### 377 Gears & Pinions, Non-Metallic

Continental-Diamond Fibre Corp., Subsidiary Budd Co.
Dominion Engineering Co., Ltd.
**HEWITT-ROBINS, INC.**
Ohio Gear Co.
Philadelphia Gear Corp.
Pittsburgh Gear Co.
Stahl Gear & Machine Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

(Geiger Counters — see Radiation Detectors)

### 378 Geologist's Equipment (Picks, Pouches, etc.)—does not include Surveying Instruments; Drafting Equipment; Geophysical Instruments; Food Packaged Kits; Laboratory Equip.

Geo Optic & Paper Corp.
Geophysical Instrument & Supply
Scott Williams Minera Co., Inc.
Stratex Instrument Co.

### 379 Geophysical Instruments —does not include Radiation Detectors; Ultra-Violet Lights—*also see* Meters

American Paulin System
Geo Optic & Paper Corp.
Geophysical Instrument & Supply
Geophysical Specialties Co.
Gurley, W. & L. E.
McPhar Geophysics, Ltd.
Moran Instrument Co.
Seismograph Service Corp.
Southwestern Industrial Electronics Co.
Texas Instruments, Inc., Geosciences & Instrumentation Div.
**VARIAN ASSOCIATES**

### 380 Graders, Road, Towed & Self-Propelled

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Austin-Western, Construction Equipment Div.
**CATERPILLAR TRACTOR CO.**
Galion Iron Works
**HUBER-WARCO CO.**
**LeTOURNEAU-WESTINGHOUSE CO.**
Midwestern Engine & Equipment Co.
Pettibone Mulliken Corp.

### 381 Gratings, Floor

Blaw-Knox Co.
Borden Metal Products Co.
**HENDRICK MFG. CO.**
Irving Subway Grating Co., Inc.

### 382 Grinders & Buffers—*see below; also see* Drill (Rock) Bit & Steel Grinders

Bay State Abrasive Products Co.
**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
Remington Arms Co., Inc.
Southwestern Engineering Co
**THOR POWER TOOL CO.**

### 383 Grinders & Buffers, Electric

Black & Decker Mfg. Co.
**CHICAGO PNEUMATIC TOOL CO.**
Penn Machine Co.
Porter-Cable Machine Co.
Remington Arms Co., Inc.
Snap-on-Tools Corp.
Southwestern Engineering Co.
**THOR POWER TOOL CO.**

### 384 Grinders & Buffers, Pneumatic

**CHICAGO PNEUMATIC TOOL CO.**
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
Penn Machine Co.
Remington Arms Co., Inc.
**THOR POWER TOOL CO.**

### 385 Grinding (& Cutting) Wheels

Bay State Abrasive Products Co.
Bitco, Inc.
Black & Decker Mfg. Co.
Macklin Co.
Norton Co.
Precision Grinding Wheel Co., Inc.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Snap-on-Tools Corp.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**WHEEL TRUEING TOOL CO.**

### 386 Grizzlies, Feeding & Moving

Chain Belt Co.
Cleveland Vibrator Co.
Davis Foundry & Machine Works
**HEWITT-ROBINS, INC.**
**LINK-BELT CO.**
**McLANAHAN & STONE CORP.**
**NORDBERG MFG. CO.**
Rogers Iron Works Co.
**ROSS SCREEN & FEEDER CO.**
Simplicity Engineering Co.
Smith Engineering Works
Sorel Steel Foundries, Ltd.
**TRAYLOR ENGRG. & MFG. CO.**
**TREADWELL, M. H., CO., INC.**
**TYLER, W. S., CO.**

### 387 Grizzlies, Stationary

**BALDWIN-LIMA-HAMILTON CORP., CONTRUCTION EQUIPMENT DIV.**
Bodinson Mfg. Co., Inc.
**CARD, C. S., IRON WORKS**
Chain Belt Co.
Davis Foundry & Machine Works
Diamond Iron Works Div., Goodman Mfg. Co.
**HEWITT-ROBINS, INC.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Lippmann Engineering Works, Inc.

Roberts & Schaefer Co. Div., Thompson-Starrett Co., Inc.
Rogers Iron Works Co.
**ROSS SCREEN & FEEDER CO.**
Smith Engineering Works
**TRAYLOR ENGRG. & MFG. CO.**
**TREADWELL, M. H., CO., INC.**

**(Grout Pumps—see Concrete; Pumps)**

### 388 Grouting, Bonding & Testing Materials—does not include Cement or Concrete Additives

**HALLIBURTON OIL WELL CEMENTING**

# H

### 389 Hardfacing Alloys Plates & Rods—*also see* Metallizing; Welding; Coatings—does not include Linings

**ALLOY RODS CO.**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
American Chain & Cable Co., Page Steel & Wire Div.
Ampco Metal, Inc.
Arcair Co.
Arcos Corp.
**CRUCIBLE STEEL CO. OF AMERICA**
Eutectic Welding Alloys Corp.
Haynes Stellite Co. Div., Union Carbide Corp.
Industrial Air Products Co.
Lincoln Electric Co.
Marquette Mfg. Co., Inc.
Metallurgical Products Dept., General Electric Co.
Rexarc, Inc., Sight Feed Generator Co.
Rockiron Co., Ltd.
**STOODY CO.**
**U. S. FOUNDRIES, INC.**
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**

**(Heaters — see below; *also* see Boilers; Dryers; Furnaces; Kilns; Retorts; Screen Heaters, Burners)**

### 390 Heaters, Process Air & Gas (Preheaters, Recuperators, Regenerators, etc.)—does not include Burners alone

Bigelow-Liptak Corp.
Farris Corp.
Farris Flexible Valve Corp.
Fuller Co.
**INGERSOLL-RAND CO.**
Kleockner-Humboldt-Deutz AG
Rockwell, W. S., Co.
Sly, W. W., Mfg. Co.
Surface Combustion Div., Midland-Ross Corp.
U. S. Hoffman Machinery Corp., Air Appliance Div.
Vulcan-Cincinnati, Inc.
**WESTERN PRECIPITATION DIV., JOY MFG. CO.**

### 391 Heaters, Space — does not include Boilers; Furnaces; Kilns; or Burners alone

**AMERICAN AIR FILTER CO., INC.**
Campbell, E. K., Co.
Carrier Corp.
Clarage Fan Co.
Cutler-Hammer, Inc.
General Electric Co., Apparatus Sales Div.
Guyan Machinery Co.
Hauck Mfg. Co., Equipment Div.
Kloeckner-Humboldt-Deutz AG
Surface Combustion Div., Midland-Ross Corp.
**WESTINGHOUSE ELECTRIC CORP.**
**WESTINGHOUSE ELECTRIC CORP., STURTEVANT DIV.**

### 392 Heat Exchangers—*also see* Boilers; Heaters; Coolers

Alco Products, Inc.
American Standard Industrial Div.
**BABCOCK & WILCOX CO.**
**BETHLEHEM STEEL CO.**
Blaw-Knox Co.
Carrier Corp.
Cochrane Corp.
Combustion Engineering, Inc.
Corning Glass Works
Duriron Co., Inc.
**EIMCO CORP.**
**ELECTRIC STEEL FOUNDRY CO.**
Kloeckner-Humboldt-Deutz AG
National Carbon Co., Union Carbide Corp.
Ogden Iron Works Co.
Pacific Coast Engineering Co.
Solar Aircraft Co.
Southwestern Engineering Co.
Vogt, Henry, Machine Co.
Vulcan-Cincinnati, Inc.
**WESTERN PRECIPITATION DIV., JOY MFG. CO.**
**WESTINGHOUSE ELECTRIC CORP.**
Wheeler, C. H., Mfg. Co.

### 393 Heavy Media Recovery Units—*for ore processing units, see* Separators, Heavy Media

Derrick Mfg. Co.
Fairmont Machinery Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Ridge Equipment Co.
Southwestern Engineering Co.
Stearns Magnetic Products
**STEARNS ROGER MFG. CO.**

### 394 Hoist Controls & Accessories, Mine Shaft—*also see* Controls

**CLARK CONTROLLER CO.**
Cutler-Hammer, Inc.
Durakool, Inc.
General Electric Co., Apparatus Sales Div.
**INDUSTRIAL PHYSICS & ELECTRONICS**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**LOGAN ENGINEERING CO.**
**MAYO TUNNEL & MINE EQUIPMENT**
**MINE SAFETY APPLIANCES CO.**
Shepard Niles Crane & Hoist Corp.
**VULCAN IRON WORKS CO.**
**WESTINGHOUSE ELECTRIC CORP.**

**Hoists—see below; refer to Winches for type of power; *also see* Cranes)**

### 395 Hoists, Dragline Scraper-Slusher

**AMERICAN HOIST & DERRICK CO.**
**GARDNER DENVER CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
**MORSE BROS. MACHINERY CO.**
Rogers Iron Works Co.
**SAUERMAN BROS., INC.**
Sorel Steel Foundries, Ltd.
**VULCAN IRON WORKS CO.**
Washington Iron Works

### 396 Hoists, Dredge, Crane & Shovel Types

**AMERICAN HOIST & DERRICK CO.**
**BALDWIN-LIMA-HAMILTON CORP. CONSTRUCTION EQUIPMENT DIV.**
Eagle Iron Works
**GEORGIA IRON WORKS CO.**
**HARNISCHFEGER CORP.**
Pacific Coast Engineering Co.
Reading Crane & Hoist Corp.
Stanco Mfg. Corp.
Superior-Lidgerwood-Mundy Corp.
Washington Iron Works
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 397 Hoists, Lift, Hand Chain & Ratchet

American Chain & Cable Co., Wright Hoist Div.
Chisholm-Moore Hoist Div., Columbus McKinnon Chain Corp.
Coffing Hoist Div., Duff-Norton Co.
Columbus McKinnon Chain Corp., Mining Equipment Div.
Denver Equipment Co.
Duff Norton Co.
Forker Corp.
Guyan Machinery Co.
Harrington Co.
Manning, Maxwell & Moore, Inc., Shaw Box Crane & Hoist Div.
Reading Crane & Hoist Corp.
Robbins & Myers, Inc.
Round & Son, Inc.
Shepard Niles Crane & Hoist Corp.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 398 Hoists, Lift, Shop Type Portable & Movable—does not include Hoists, Lift, Hand Chain

Baker Industrial Trucks Div., Otis Elevator Co.
**CHICAGO PNEUMATIC TOOL CO.**
Coffing Hoist Div., Duff-Norton Co.
Denver Equipment Co.
Duff Norton Co.
Forker Corp.
**GARDNER DENVER CO.**
Guyan Machinery Co.
**JOY MFG. CO.**
Manning, Maxwell & Moore, Inc., Shaw Box Crane & Hoist Div.
Robbins & Myers, Inc.
Round & Son, Inc.
Shepard Niles Crane & Hoist Corp.
**THOR POWER TOOL CO.**
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 399 Hoists, Lift, Shop Type Stationary

Chisholm-Moore Hoist Div., Columbus McKinnon Chain Corp.
Duff Norton Co.
Essick Mfg. Co.
Guyan Machinery Co.
**JOY MFG. CO.**
**LeTOURNEAU, INC.**
Manning, Maxwell & Moore, Inc., Shaw Box Crane & Hoist Div.
Robbins & Myers, Inc.
Shepard Niles Crane & Hoist Corp.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 400 Hoists, Mine Shaft Drum — does not include Sheaves; Skips & Cages; Buckets

**ASEA ELECTRIC, INC.**
Coeur D'Alenes Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Dominion Engineering Co., Ltd.
Essick Mfg. Co.
**HEWITT-ROBINS, INC.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Lake Shore, Inc., Lake Shore Engineering Div.
Lidgerwood Mfg. Co.
**MORSE BROS. MACHINERY CO.**
**NORDBERG MFG. CO.**
Pacific Coast Engineering Co.
Rogers Iron Works Co.
**STEARNS ROGER MFG. CO.**
Superior-Lidgerwood-Mundy Corp.
**VULCAN IRON WORKS CO.**
Washington Iron Works

### 401 Hoists, Mine Shaft Friction—does not include Sheaves, Skips & Cages; Buckets

**ASEA ELECTRIC, INC.**
**CONNELLSVILLE MFG. & MINE SUPPLY**
**INGERSOLL-RAND CO.**
Lidgerwood Mfg. Co.
**MAYO TUNNEL & MINE EQUIPMENT**
**NORDBERG MFG. CO.**
Rogers Iron Works Co.
**VULCAN IRON WORKS CO.**

**(Hoists Tugger—see Winches)**

### 402 Hose, Air, Steam, Water et al

**ACME HAMILTON MFG. CORP.**
Aeroquip Corp.
Aeroquip Corp., Western Div.
**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
American Rubber Mfg. Co.
Anchor Coupling Co.
Bitco, Inc.
**CHICAGO PNEUMATIC TOOL CO.**
Cincinnati Rubber Mfg. Co. Div., Thor Power Tool Co.
Continental Rubber Works

Eastman-Pacific Co.
**EIMCO CORP.**
**FLEXAUST CO.**
Fyr-Fyter Co.
**GARDNER DENVER CO.**
**GATES RUBBER CO.**
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**GOODYEAR TIRE & RUBBER CO.**
Gray & Co., Inc.
**HEWITT-ROBINS, INC.**
Industrial Air Products Co.
**INGERSOLL-RAND CO.**
Johnson Corp.
**JOY MFG. CO.**
Korfund Co., Inc.
Megator Corp.
Mercer Rubber Co.
Owatonna Tool Co.
Parker-Hannifin Corp.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Republic Rubber Div., Lee Rubber & Tire Corp.
Schramm, Inc.
Stratoflex, Inc.
Thermoid Div., H. K. Porter Co., Inc.
**THOR POWER TOOL CO.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Weatherhead Co., Fort Wayne Div.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 403 Hose Fittings—Clamps, Couplings, Swivel Joints, etc.

Aeroquip Corp.
Aeroquip Corp., Western Div.
Anchor Coupling Co.
Chase Brass & Copper Co.
**CHICAGO PNEUMATIC TOOL CO.**
Chiksan Co.
Cincinnati Rubber Mfg. Co. Div., Thor Power Tool Co.
Continental Rubber Works
Dixon Valve & Coupling Co.
Eastman-Pacific Co.
Fyr-Fyter Co.
**GATES RUBBER CO.**
Goodall Rubber Co.
**GOODYEAR TIRE & RUBBER CO.**
Guyan Machinery Co.
**HEWITT-ROBINS, INC.**
Hose Accessories Co.
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Knox Mfg. Co.
Lincoln Engineering Co. Div., McNeil Machine & Engineering Co.
Lunkenheimer Co.
Megator Corp.
OPW-Jordan Corp.
Owatonna Tool Co.
Parker-Hannifin Corp.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Schramm, Inc.
Stratoflex, Inc.
**THOR POWER TOOL CO.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**VICTAULIC CO. OF AMERICA**
Weatherhead Co., Fort Wayne Div.

### 404 Hubs, Auto Wheel, Selective Drive

**WARN MFG. CO.**

**(Hydraulic Cylinders — *see* Cylinders, Air & Hydraulic)**

**(Hydraulic Monitors — *see* Monitors)**

### 405 Hydraulic Motors

American Brake Shoe Co.
Commercial Shearing & Stamping Co.
**LINK-BELT CO.**
Oilgear Co.
Owatonna Tool Co.
Rockwell Mfg. Co.
Vickers, Inc.

**(Hydraulic Pumps — *see* Pumps, Hydraulic Fluid)**

**(Hydraulic Rams—*see* Pumps, Hydraulic Ram)**

**(Hydrometer — *see* Meters, Liquid Density)**

## I

**(Instruments — *see* Drafting Equipment; Geophysical Instruments; Chemical Laboratory Equipment; Laboratory & Scientific Instruments, Equipment & Supplies; Meters; Surveying Equipment)**

### 406 Insulating Materials, Electrical

Continental-Diamond Fibre Corp., Subsidiary Budd Co.
**COORS PORCELAIN CO.**
Dow Corning Corp.
**G & W ELECTRIC SPECIALTY CO.**
Garlock, Inc.
**HARDINGE CO., INC.**
Keasbey & Mattison Co.
Minnesota Mining & Mfg. Co.
**OHIO BRASS CO.**
Sherwin-Williams Co.
Synthane Corp.
Taylor Fibre Co.
U. S. Stoneware Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 407 Insulating Materials Moisture & Gas

Pittsburgh Corning Corp.

### 408 Insulating Materials, Sound

Albany Felt Co.
Eagle-Picher Co.
Gustin-Bacon Mfg. Co.
**JOHNS-MANVILLE**
Keasbey & Mattison Co.
Minnesota Mining & Mfg. Co.
Pittsburgh Corning Corp.

### 409 Insulating Materials, Thermal, Block — *also see* Refractories

Bigelow-Liptak Corp.
Carey, Philip, Mfg. Co.
Dow Corning Corp.
Eagle-Picher Co.
Garlock, Inc.
Gladding, McBean & Co.
Green Fire Brick Co.
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc.
Keasbey & Mattison Co.
Pittsburgh Corning Corp.
Ruberoid Co.
Walsh Refractories Corp.

### 410 Insulating Materials, Thermal, Bulk *also see* Refractories

Bigelow-Liptak Corp.
Carey, Philip, Mfg. Co.
Eagle-Picher Co.
Gladding, McBean & Co.
Green Fire Brick Co.
Gustin-Bacon Mfg. Co.
**HARBISON - WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc.
Ruberoid Co.

### 411 Insulating Materials, Thermal, Castable & Cement Compounds—*also see* Refractories

**BABCOCK & WILCOX CO.**
Bigelow-Liptak Corp.
Carey, Philip, Mfg. Co.
Eagle-Picher Co.
Gladding, McBean & Co.
Green Fire Brick Co.
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc.
Robinson Clay Product Co.
Walsh Refractories Corp.

### 412 Insulating Materials, Thermal, Cloth & Paper

Albany Felt Co.
Eagle-Picher Co.
Garlock, Inc.
Gladding, McBean & Co.
**JOHNS-MANVILLE**
Keasbey & Mattison Co.
Minnesota Mining & Mfg. Co.

### 413 Ion Exchange Equipment (Special)—does not include standard auxiliary equipment; *also see* Water Clarification

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Chemical Separations Corp.
Cochrane Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Graver Water Conditioning Co., Union Tank Car Co. Div.
Ionics, Inc.
Ledoux & Co., Inc.
Multi-Metal Wire Cloth Co., Inc.
**STEARNS ROGER MFG. CO.**

### 414 Ion Exchange Resins

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Baker Chemical Co.
Cochrane Corp.
Dow Chemical Co.
Fisher Scientific Co.
Graver Water Conditioning Co., Union Tank Car Co. Div.
Hagan Chemicals & Controls, Inc., Calgon Co., Hall Laboratories
Nalco Chemical Co.
Permutit Co. Div., Pfaudler Permutit, Inc.
Rohm & Haas Co.

## J

### 415 Jacks, Lifting, (Screw, Hydraulic, etc.) — *also see:* Hoists; Jacks, Roof

Anthony Co.
Baker Industrial Trucks Div., Otis Elevator Co.
Caster Mold & Machine Co.
Commercial Shearing & Stamping Co.
Duff Norton Co.
Foster, L. B., Co.
Guyan Machinery Co.
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
Owatonna Tool Co.
Templeton, Kenly & Co.

**(Jacks, Pulling—*see* Hoists)**

### 416 Jacks, Roof — *also see* Mine Supports, Re-usable Props

**INTERNATIONAL NICKEL CO.**
Duff Norton Co.
Foster, L. B., Co.
Irwin Sensenich Corp.
Midwestern Engine & Equipment Co.
**NATIONAL MINE SERVICE CO.**
Templeton, Kenly & Co.

**(Jigs—*see* Separators, Jig)**

## K

### 417 Kiln (& Industrial) Guns (Declogging)—does not include Refractory Placers

Long-Airdox Co., Marmon-Herrington, Inc.
Remington Arms Co., Inc.

**(Kilns, Roasters & Dryers—see below; *also see* Dryers; Furnaces; Retorts; Sintering Equipment)**

### 418 Kilns, Roasters & Dryers, Beehive, Tunnel & Single Hearth (Stationary & Moving)

Alco Products, Inc.
Blaw-Knox Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
Hevi-Duty Electric Co.
Surface Combustion Div., Midland-Ross Corp.
Universal Dredge Mfg. Co.

### 419 Kilns, Roasters & Dryers, Multiple-Hearth (Mechanical Rabble) Tower

Alco Products, Inc.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**ELECTRIC STEEL FOUNDRY CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hevi-Duty Electric Co.
Kloeckner-Humboldt-Deutz AG
Link-Belt Co.
**NICHOLS ENGINEERING & RESEARCH CORP.**
**NORDBERG MFG. CO.**
Surface Combustion Div., Midland-Ross Corp.

### 420 Kilns, Roasters & Dryers, Rotary

Alco Products, Inc.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BETHLEHEM STEEL CO.**
Carpco Mfg., Inc.
**DIESEL ENERGY CORP.**
**ELECTRIC STEEL FOUNDRY CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**GOULD, GORDON I., CO.**
Hack Engineering Co.
**HARDINGE CO., INC.**
Hevi-Duty Electric Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Link-Belt Co.
**McNALLY PITTSBURG MFG. CORP.**
**SMIDTH, F. L., & CO.**
**STEARNS ROGER MFG. CO.**
Stroh Process Steel Co.
Surface Combustion Div., Midland-Ross Corp.
**TRAYLOR ENGRG. & MFG. CO.**
Universal Dredge Mfg. Co.

**(Kilns, Roaster & Dryers, Shaft — *see* Furnaces, Shafts)**

# L

### 421 Laboratory & Scientific Instruments, Equipment & Supplies other than Chemicals, Chemical Lab. Equip., Geophysical Instruments, Drafting Equipment, Surveying Equipment — *also see* Meters

Abbe Engineering Co.
**BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP.**
Bausch & Lomb Optical Co., Scientific Products Div.
Beach-Russ Co.
Beckman Instrument Inc., Scientific Process Instruments Div.
Bico, Inc.
Booth Co., Inc.
Bristol Co.
Cahn Instrument Corp.
**COORS PORCELAIN CO.**
Denver Equipment Co.
Duriron Co., Inc.
Engelhard Industries, Inc.
Esterline-Angus Co., Inc.
Fisher Scientific Co.
Galigher Co.
General Electric Co., Apparatus Sales Div.
Geo Optic & Paper Corp.
Geophysical Instrument & Supply
Gilson Screen Co.
Graver Water Conditioning Co., Union Tank Car Co. Div.
Gurley, W. & L. E.
Jarrell-Ash Co.
Kloeckner-Humboldt-Deutz AG
Laboratory Equipment Corp.
Leeds & Northrup Co.
Magnaflux Corp.
**MINE & SMELTER SUPPLY CO.**
**MIXING EQUIPMENT CO.**
Moran Instrument Co.
Morse Bros. Machinery Co.
Norton Co.
OPW-Jordan Corp.
Precision Thermometer & Instrument Co.
Southwestern Industrial Electronics Co.
Special Instruments Laboratory, Inc.
Texas Instruments, Inc., Geosciences & Instrumentation Div.
Torsion Balance Co.
U. S. Stoneware Co.
Wallace & Tiernan, Inc.

### 422 Laboratory Service, Chemical Analyzing & Assaying

Arizona Testing Laboratories
California Testing Laboratories
Chapman, Wood & Griswold, Ltd.
Custom Assay Office
Denver Equipment Co.
Dickinson Laboratories, Inc.
**DORR OLIVER, INC.**
El Paso Testing Laboratory, Ltd.
Hanks, Abbot A., Inc.
Hawley & Hawley Assayers & Chemists, Inc.
Jarrell-Ash Co.
Ledoux & Co., Inc.
McPhar Geophysics, Ltd.
Nichols Laboratories, Inc.
Smith-Emery Co.
Spectrochemical Laboratories, Inc.

### 423 Laboratory Service Mineral Determination

Arizona Testing Laboratories
California Testing Laboratories
Carpco Mfg., Inc.
Custom Assay Office
Denver Equipment Co.
Dickinson Laboratories, Inc.
**DORR OLIVER, INC.**
El Paso Testing Laboratory, Ltd.
Galigher Co.
Goodall Brothers
Hanks, Abbot A., Inc.
Jarrell-Ash Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Ledoux & Co., Inc.
Scott Williams Mineral Co., Inc.
Smith-Emery Co.
Southwestern Engineering Co.
Spectrochemical Laboratories, Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 424 Laboratory Service, Testing other than chemical & mineral above—*also see* Consultants; Contractors

Arizona Testing Laboratories
Blaw-Knox Co.
Booth Co., Inc.
California Testing Laboratories
Chemical Separations Corp.
Custom Assay Office
Dickinson Laboratories, Inc.
El Paso Testing Laboratory, Ltd.
Galigher Co.
Hagan Chemicals & Controls, Inc., Calgon Co., Hall Laboratories
**HALLIBURTON OIL WELL CEMENTING**
Kloeckner-Humboldt-Deutz AG
Ledoux & Co., Inc.
Magnaflux Corp.
Nalco Chemical Co.
Smith-Emery Co.
Southwestern Engineering Co.
Spectrochemical Laboratories, Inc.
Stearns Magnetic Products
Ultra-Violet Products, Inc.

### 425 Lighting Fixtures & Lamps, Industrial (Electric)—*also see* Flood Lights

Day-Ray Products, Inc.
Haynes Stellite Co. Div., Union Carbide Corp.
Ideal Industries, Inc.
Line Material Industries, McGraw-Edison Co.
**MINE SAFETY APPLIANCES CO.**
Phoenix Products Co.
Ray-O-Vac Co.
**WESTINGHOUSE ELECTRIC CORP.**

**(Liquids & Claddings—*see* below; *also see* Furnace Linings; Insulating Materials; Steel, Alloy; Tanks, Lined; does not include Coatings)**

**(Linings & Claddings, Abrasion Resistant Metallic—*see* Steel, Alloy—does not include Coatings)**

### 426 Linings & Claddings Abrasion, Resistant, Non-Metallic

Amercoat Corp.
**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
Bigelow-Liptak Corp.
Byers, A. M., Co.
Carboline Co.
Denver Equipment Co.
Galigher Co.
Garlock, Inc.
**GOODYEAR TIRE & RUBBER CO.**
Hauser-Stander Tank Co.
**LINATEX CORP. OF AMERICA**
Norton Co.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Thermoid Div., H. K. Porter Co., Inc.
U. S. Stoneware Co.

### 427 Linings & Claddings, Corrosion-Resistant Metallic—*also see* Steel, Alloy; Tanks, Lined—does not include Coatings

Amercoat Corp.
Ampco Metal, Inc.
**BABCOCK & WILCOX CO.**
Carboline Co.
Colorado Fuel & Iron Corp.
Denver Equipment Co.
**ELECTRIC STEEL FOUNDRY CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hauser-Stander Tank Co.
Haynes Stellite Co. Div., Union Carbide Corp.
Metal Goods Corp.
Thermoid Div., H. K. Porter Co., Inc.

### 428 Linings & Claddings, Corrosion-Resistant, Non-Metallic—*also see* Tanks, Lined—does not include Coatings

Amercoat Corp.
Arrow Tank Co.
Bigelow-Liptak Corp.
Byers, A. M., Co.
Denver Equipment Co.
Galigher Co.
Garlock, Inc.
Hauser-Stander Tank Co.
**LINATEX CORP. OF AMERICA**
Luzerne Rubber Co.
National Carbon Co., Union Carbide Corp.
Pipe Linings, Inc.
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Thermoid Div., H. K. Porter Co., Inc.
U. S. Stoneware Co.

**(Loaders—*see* below; *also see* Conveyors; Dredges; Excavators; Scrapers; Trucks & Trailers Self-Loading)**

### 429 Loaders, Boxcar

Baker Industrial Trucks Div., Otis Elevator Co.
**EIMCO CORP.**
Hough, Frank G., Co.
Link-Belt Co.
OPW-Jordan Corp.
Stephens-Adamson Mfg. Co.

### 430 Loaders, Front-End Scoop, Crawler-Tractor —does not include overcast type

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Case, J. I., Co., Industrial Div.
**CATERPILLAR TRACTOR CO.**
**DEERE & CO.**
**DROTT MFG. CORP.**
**EIMCO CORP.**
**GARDNER DENVER CO.**
Hough, Frank G., Co.
Koehring Co.
**MACHINERY CENTER, INC.**
Midwestern Engine & Equipment Co.
Oliver Corp.

### 431 Loaders, Front-End Scoop, Wheeled Tractor does not include overcast type

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Case, J. I., Co., Industrial Div.
**CATERPILLAR TRACTOR CO.**
**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV.**
**DEERE & CO.**
**EUCLID DIV., GENERAL MOTORS CORP.**
Federal Motor Truck Div., Napco Industries, Inc.
Hough, Frank G., Co.
Midwestern Engine & Equipment Co.
Oliver Corp.
Pettibone Mulliken Corp.
Thew Shovel Co.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 432 Loaders, Gathering-Head, Mine-Type—*also see* Loaders, Self-loading Conveyor

Athey Products Corp.
**GARDNER DENVER CO.**
Goodman Mfg. Co.
Jeffrey Mfg. Co.
**JOY MFG. CO.**
Long-Airdox Co., Marmon-Herrington, Inc.
Myers-Whaley Co., Inc.

### 433 Loaders, Overcasting Bucket, Mine-Type Crawler, Rail & Wheeled

**AMERICAN HOIST & DERRICK CO.**
**ATLAS COPCO**
**EIMCO CORP.**

### 434 Loaders, Scraper-Slusher Movable Ramp

**JOY MFG. CO.**
**MACHINERY CENTER, INC.**
Midwestern Engine & Equipment Co.
Rogers Iron Works Co.

### 435 Loaders, Self-Loading Conveyor, (Chain, Belt, Bucket-Line, etc.) With Digging Component — does not include Excavators or Conveyor alone.

*Also see* Loaders, Gather-Head, Mine-Type

Bonded Scale & Machine Co.
Christian, J. D., Engineers
**EIMCO CORP.**
**HEWITT-ROBINS, INC.**
Industrial Engineering & Construcion Co.
**MACHINERY CENTER, INC.**
Myers-Whaley Co., Inc.
Sanford-Day Iron Works, Inc.
**WESTERN CONVEYOR CO.**

### 436 Loaders, Special Mine Shaft Mucking

**ALIMAK CORP.**
**EIMCO CORP.**
**GARDNER DENVER CO.**
**JOY MFG. CO.**
**MACHINERY CENTER, INC.**
Shaft & Development Machines, Inc.
**VULCAN IRON WORKS CO.**

### 437 Loaders, Special Tunnel Mucking—*also see* Trucks & Trailers, Special Self-Loading

Coeur D'Alenes Co.
**EIMCO CORP.**
Goodman Mfg. Co.
**MACHINERY CENTER, INC.**
Myers-Whaley Co., Inc.
**THOR POWER TOOL CO.**

### 438 Loading Attachments, Special for Self-Loading Vehicles

Anthony Co.
Colorado Fuel & Iron Corp.
**EIMCO CORP.**
**MACHINERY CENTER, INC.**

### (Loading Booms—*see* Conveyors; Cranes)

### 439 Locomotives, Compressed Air

**EIMCO CORP.**
Hack Engineering Co.
**MAYO TUNNEL & MINE EQUIPMENT**
Universal Dredge Mfg. Co.

### 440 Locomotives, Electric Battery & Trolley

**ATLAS CAR & MFG. CO.**
**DIFFERENTIAL STEEL CAR CO.**
Goodman Mfg. Co.
Ironton Engine Co.
Jeffrey Mfg. Co.
Kersey Mfg. Co., Inc.
**MANCHA STORAGE BATTERY LOCOMOTIVE DIV., GOODMAN MFG. CO.**
**MORSE BROS. MACHINERY CO.**
**NATIONAL MINE SERVICE CO.**

### 441 Locomotives, Gasoline, Diesel & Diesel-Electric

Alco Products, Inc.
**ATLAS CAR & MFG. CO.**
Brookville Locomotive Works
**DIESEL ENERGY CORP.**
**DIFFERENTIAL STEEL CAR CO.**
**FAIRBANKS, MORSE & CO.**
**FATE-ROOT HEATH CO.**
General Electric Co., Apparatus Sales Div.
Hack Engineering Co.
Kloeckner-Humboldt-Deutz AG
**MANCHA STORAGE BATTERY LOCOMOTIVE DIV., GOODMAN MFG. CO.**
**MAYO TUNNEL & MINE EQUIPMENT**
**NATIONAL MINE SERVICE CO.**
Universal Dredge Mfg. Co.

### 443 Lubricants

Alpha Molykote Corp.
Atlantic Refining Co.
Emerol Mfg. Co.
Esso Standard Div., Humble Oil & Refining Co.
**FISKE BROS. REFINING CO., LUBRI-PLATE DIV.**
Gulf Oil Corp.
Hulburt Oil & Grease Co.
Imperial Oil & Grease
Jet-Lube, Inc.
Keystone Lubricating Co.
**LESCHEN WIRE ROPE DIV., H. K. PORTER CO., INC.**
Nalco Chemical Co.
**OHIO BRASS CO.**
Ohio Oil Co.
Phillips Petroleum Co.
Shell Oil Co.
**STANDARD OIL CO. OF CALIFORNIA, WESTERN OPERATIONS, INC.**
Sta-Vis Oil Co.
**STEWART - WARNER CORP., ALEMITE DIV.**
Sun Oil Co.
**TEXACO, INC.**
Tidewater Oil Co.
Whitmore Mfg. Co.

### 444 Lubricating Equipment

Emerol Mfg. Co.
Gray & Co., Inc.
Farval Div., Eaton Mfg. Co.
Hulburt Oil Grease Co.
Lincoln Engineering Co., Div. McNeil Machine & Engineering Co.
Lunkenheimer Co.
Manzel Div., Houdaille Industries, Inc.
**NORDBERG MFG. CO.**
**STEWART - WARNER CORP., ALEMITE DIV.**
Tidewater Oil Co.
Trabon Engineering Co.
Trico Fuse Mfg. Co.

# M

### 445 Magnets—*also see* Separators, Magnetic; Heavy Media Recovery units

Carpco Mfg., Inc.
**CRUCIBLE STEEL CO. OF AMERICA**
Cutler-Hammer Inc.
**DINGS MAGNETIC SEPARATOR CO.**
**ERIEZ MFG. CO.**
Geophysical Instrument & Supply
**MACHINERY CENTER, INC.**
Magnaflux Corp.
Magnetic Engineering & Mfg. Co.
Metallurgical Products Dept., General Electric Co.
Quick-Way Truck Shovel Co.
Stackpole Carbon Co.
Stearns Magnetic Products

### 446 Maps, Geographic—does not include Contractors, Mapping

American Air Surveys, Inc.
Geo Optic & Paper Corp.

### 447 Metallizing Equipment

Metallizing Engineering Co., Inc.

### 448 Metallizing Supplies — *also see* Welding Supplies; Hardfacing Alloys

American Chain & Cable Co., Page Steel & Wire Div.
Belmont Smelting & Refining Works
Metallizing Engineering Co., Inc.
Sylvania Electric Products, Inc., Chemical & Metallurgical Div.

### 449 Meters & Gages, etc., Chemical (pH Polarograph, etc.) *also see* Spectrographic Instruments

Analytical Measurements, Inc.
**BAILEY METER CO.**
Beckman Instrument, Inc., Scientific Process Instruments Div.
Bristol Co.
Fisher Scientific Co.
Hays Corp.
Leeds & Northrup Co.
**LONGYEAR CO.**
Minneapolis-Honeywell Regulator
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Nalco Chemical Co.
OPW-Jordan Corp.

### 450 Meters & Gages, etc., Counting

General Electric Co., Apparatus Sales Div.
Beckman Instrument, Inc., Scientific Process Instruments Div.
Bristol Co.
Daystrom, Inc., Weston Instruments Div.
Esterline-Angus Co., Inc.
Fisher Scientific Co.
**HERCULES POWDER CO.**
Leeds & Northrup Co.
Southwestern Industrial Electronics Co.
**WESTINGHOUSE ELECTRIC CORP.**

### 451 Meters & Gages, etc., Electricity (Ammeters, Voltmeters, Et Al)

B-I-F Industries, Inc.
**BAILEY METER CO.**
Bristol Co.
Crosby Valve & Gage Co.
Daystrom, Inc., Weston Instruments Div.
Fisher Scientific Co.
**FOXBORO CO.**
General Electric Co., Apparatus Sales Div.
Gray & Co., Inc.

Hagan Chemicals & Controls Inc., Calgon Co., Hall Laboratories
Hays Corp.
Infilco, Inc.
Leeds & Northrup Co.
Megator Corp.
Minneapolis-Honeywell Regulator
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Owatonna Tool Co.
Precision Thermometer & Instrument Co.
Revere Corp. of America, Neptune Meter Co.
Rockwell Mfg. Co.
U. S. Gauge Div., American Machine & Metals
Wallace & Tiernan, Inc.

### 452 Meters & Gages, etc., (Flow, Pressure & Vacuum)

General Electric Co., Apparatus Sales Div.

### 453 Meters & Gages, Hardness Testing

Fisher Scientific Co.
General Electric Co., Apparatus Sales Div.
Magnaflux Corp.

### 454 Meters & Gages, Indicating & Measuring Devices & Instruments (Remote, Recording, etc.)—see below; *also see* Bin-Level Indicators; Communications; Controls; Drafting Instruments; Gas (& Moisture) Detectors; Geophysical Instruments; Chemical Laboratory Equipment; Laboratory & Scientific Instruments; Scales; Surveying Instruments. Spectroscopic Instruments

AGA Corp. of America
Analytical Measurements, Inc.
B-I-F Industries, Inc.
**BAILEY METER CO.**
Beckman Instrument, Inc., Scientific Processs Instruments Div.
Bristol Co.
Crosby Valve & Gage Co.
Daystrom, Inc., Weston Instruments Div.
Esterline-Angus Co., Inc.
Fisher Research Laboratory, Inc.
**FOXBORO CO.**
General Electric Co., Apparatus Sales Div.
Geo Optic & Paper Corp.
Geodimeter Co.
Goldak Co., Inc.
Graver Water Conditioning Co., Union Tank Car Co., Div.
Gurley, W. & L. E.
Hagan Chemicals & Controls, Inc., Calgon Co., Hall Laboratories
Hays Corp.
Industrial Nucleonics Corp.
**INDUSTRIAL PHYSICS & ELECTRONICS**
Infilco, Inc.
Leeds & Northrup Co.
Lufkin Rule Co.
Magnaflux Corp.
**MERRICK SCALE MFG. CO.**
Minneapolis-Honeywell Regulator
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Moran Instrument Co.
Ohmart Corp.
Precision Thermometer & Instrument Co.
Rockwell Mfg. Co.
Special Instruments Laboratory, Inc.
Streeter-Amet Co.
Texas Instruments, Inc., Geosciences & Instrumentation Div.
U. S. Gauge Div., American Machine & Metals
Wallace & Tiernan, Inc.
**WESTINGHOUSE ELECTRIC CORP.**
Yarnall-Waring Co.

### 455 Meters & Gages, etc. Linear Measure (Calipers, Micrometers, Extensometers, Et Al)

Daystrom, Inc., Weston Instruments Div.
Fisher Scientific Co.
Lufkin Rule Co.

### 456 Meters & Gages, etc., Liquid (& Slurry) Density

**BAILEY METER CO.**
Fisher Scientific Co.
**FOXBORO CO.**
**INDUSTRIAL CONTROLS DEPT., CURTISS-WRIGHT CORP.**
Industrial Nucleonics Corp.
Leeds & Northrup Co.
Manzel Div., Houdaille Industries, Inc.
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Ohmart Corp.
Precision Thermometer & Instrument Co.

### 457 Meters & Gages etc., Speed (Tachometer, Et Al)

**BAILEY METER CO.**
Bristol Co.
Daystrom, Inc., Weston Instruments Div.
Esterline-Angus Co., Inc.
**FOXBORO CO.**
General Electric Co., Apparatus Sales Div.
Ideal Industries, Inc.
**INDUSTRIAL CONTROLS DEPT., CURTISS-WRIGHT CORP.**
Leeds & Northrup Co.
Metron Instrument Co.
Minneapolis-Honeywell Regulator
Minneapolis - Honeywell Regulator, Brown Instrument Div.

### 458 Meters & Gages, etc., Strain, Pressure, Weight—does not include Meters & Gages, Fluid (Pressure); Meters & Gages, Linear Measure; Scales

**FOXBORO CO.**
Leeds & Northrup Co.
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Revere Corp. of America, Neptune Meter Co.
Wallace & Tiernan, Inc.

### 459 Meters & Gages, etc., Temperature (Thermometers, Pyrometers, etc.)

**BAILEY METER CO.**
Bristol Co.
Daystrom, Inc., Weston Instruments Div.
Eastman-Pacific Co.
Fisher Scientific Co.
**FOXBORO CO.**
General Electric Co., Apparatus Sales Div.
Leeds & Northrup Co.
Minneapolis-Honeywell Regulator
Minneapolis - Honeywell Regulator, Brown Instrument Div.
Precision Thermometer & Instrument Co.
Revere Corp. of America, Neptune Meter Co.

### 460 Meters & Gages, etc., Time (Clocks, etc.)

General Electric Co., Apparatus Sales Div.

### 461 Mill Balls & Similar Media, Grinding

Abbe Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Calumet Div., Calumet & Hecla, Inc.
Colorado Fuel & Iron Corp.
**COORS PORCELAIN CO.**
Crossley Machine Co.
Endicott Forging & Mfg. Co.
Fagersta Steels, Inc.
Galigher Co.
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**MINE & SMELTER SUPPLY CO.**
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
Sheffield Div., Armco Steel Corp.
Southwestern Engineering Co.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
U.S. Stoneware Co.

### 462 Mill Liners, Grinding

Abbe Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Atlas Steel Casting Co.
**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
Calumet Div., Calumet & Hecla, Inc.
Coeur D'Alenes Co.
**COORS PORCELAIN CO.**
Crossley Machine Co.
Denver Equipment Co.
**EIMCO CORP.**
**ELECTRIC STEEL FOUNDRY CO.**
Frog, Switch & Mfg. Co.
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**LINATEX CORP. OF AMERICA**
Meehanite Corp.
**MINE & SMELTER SUPPLY CO.**
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV.**
**NORDBERG MFG. CO.**
**SMIDTH, F. L., & CO.**
Sorel Steel Foundries, Ltd.
Taylor Wharton Div., Harsco Corp.
Thomas Foundries, Inc.
Tool Steel Gear & Pinion Co.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
U. S. Stoneware Co.

### 463 Mill Rods, Grinding

Abbe Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Colorado Fuel & Iron Corp.
**COORS PORCELAIN CO.**
Denver Equipment Co.
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**MINE & SMELTER SUPPLY CO.**
Tool Steel Gear & Pinion Co.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
U. S. Stoneware Co.

### 464 Mill Shells, Grinding

Abbe Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BALDWIN - LIMA - HAMILTON CORP., STANDARD STEEL WORKS DIV.**
Denver Equipment Co.
**ELECTRIC STEEL FOUNDRY CO.**
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
**MINE & SMELTER SUPPLY CO.**
**NORDBERG MFG. CO.**
**SMIDTH, F. L., & CO.**
Tool Steel Gear & Pinion Co.
U. S. Stoneware Co.

### 465 Mills, Grinding Autogenous

Dominion Engineering Co., Ltd.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HARDINGE CO., INC.**
Kloeckner-Humboldt-Deutz AG
Majac, Inc.
**MINE & SMELTER SUPPLY CO.**

### 466 Mills, Grinding, Ball, Pebble, Rod & Tube

Abbe Engineering Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Bico, Inc.
Dominion Engineering Co., Ltd.
**COATES STEEL PRODUCTS CO.**
Crossley Machine Co.
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**EIMCO CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HAMMERMILLS, INC.**
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINATEX CORP. OF AMERICA**
**MINE & SMELTER SUPPLY CO.**
Morse Bros. Machinery Co.
**NORDBERG MFG. CO.**
**SMIDTH, F. L., & CO.**
**STEARNS ROGER MFG. CO.**
**STRAUBE MFG. CO.**
**TRAYLOR ENGRG. & MFG. CO.**
U. S. Stoneware Co.

**467 Mills, Mobile Unit (Complete Ore Dressing)—does not include Crushers, Mobile Units alone**

Denver Equipment Co.
Hack Engineering Co.
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WESTERN MACHINERY CO., WEMCO DIV.**

**(Mills, Pug—see Scrubbers)**

**(Mine Cars—see Cars, Mine)**

**468 Mine Doors (including Automatic Pressure, Safety, Watertight, etc.)**

**AMERICAN MINE DOOR CO.**
**NATIONAL MINE SERVICE CO.**
Rockiron Co., Ltd.

**(Mine Supports—see below; *also see* Steel; Rock Bolts; Fencing; Metal Wire)**

**469 Mine Supports, Metal Props (including reuseable, movable & yielding types)**

Acrow Crop. of America
**BETHLEHEM STEEL CO.**
Irwin Sensenich Corp.
**OHIO BRASS CO.**
Templeton, Kenly & Co.

**470 Mine Supports, Metal, Sets & Arch Plates**

**BETHLEHEM STEEL CO.**
Commercial Shearing & Stamping Co.
Irwin Sensenich Corp.
**LINK-BELT CO.**
Rockiron Co., Ltd.

**471 Mine Supports, Metal Yieldable Sets & Arches**

**BETHLEHEM STEEL CO.**
Rockiron Co., Ltd.

**472 Mineral Dealers & Sales Agents**

Associated Metals & Minerals Corp.
**CLIMAX MOLYBDENUM CO.**
De Sousa, J. E., Co., Inc.
**DIAMOND, T. L.**
Freeport Sulphur Co.
Godoy, E. A., & Co., Inc.
**INTERNATIONAL BARTERING CO.**
**PHELPS DODGE REFINING**
Scott Williams Minera Co., Inc.
Texas Gulf Sulphur Co.
Wah Chang Corp.

**474 Mineral Specimens**

Geophysical Instrument & Supply
Scott Williams Minera Co., Inc.

**(Mixers—see Agitators)**

**475 Monitor Hydraulic (Water)**

Chiksan Co.
**GEORGIA IRON WORKS CO.**
Special Instruments Laboratory, Inc.

**476 Monorail Transports, Ground—does not include Trolley types; *also* see Rail or Track**

Chain Belt Co.
Hack Engineering Co.
Shepard Niles Crane & Hoist Corp.

**477 Monorail Transports, does not include Conveyors, Trolley; Cranes, Overhead Traveling; Aerial Cableways**

Chisholm-Moore Hoist Div., Columbus McKinnon Chain Corp.
Guyan Machinery Co.
Louden Machinery Co.
Shepard Niles Crane & Hoist Corp.

**(Motors — *see* Air Motors; Electric Motors, Hydraulic Motors)**

**(Mucking Machines — *see* Loaders)**

# N

**478 Nodulizing Equipment—*also see* Sintering Equipment; Pelletizing Equip.; Briquetting Equip.**

**KENNEDY VAN SAUN MFG. & ENG. CORP.**
McDowell Co., Inc., Wellman Engineering Co.
**STANDARD STEEL CORP.**

**479 Nozzles—does not include Monitors, Hydraulic**

Bete Fog Nozzle, Inc.
Bitco, Inc.
Chain Belt Co.
**COORS PORCELAIN CO.**
**DEISTER CONCENTRATOR CO.**
**ELECTRIC STEEL FOUNDRY CO.**
Fairmont Machinery Co.
Megator Corp.
OPW-Jordan Corp.
**SPRAYING SYSTEMS CO.**
Yarnall-Waring Co.

# O

**480 Office Machines & Equipment — does not include Computing Machines; Drafting Equip.**

Minnesota Mining & Mfg. Co.
Peerless Photo Products, Inc.
Remington Rand Div., Sperry Rand Corp.

**(Ore Dealers — *see* Mineral Dealers and Sales Agents)**

# P

**482 Packing**

**ACME HAMILTON MFG. CORP.**
**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV.**
Belmont Packing & Rubber Co.
Continental Rubber Works
Flood City Brass & Elec. Co.
Garlock, Inc.
Goodall Rubber Co.
Greene, Tweed & Co.
Guyan Machinery Co.
**JOHNS-MANVILLE**
**RAYBESTOS-MANHATTAN, INC., MANHATTAN RUBBER DIV.**
Republic Rubber Div., Lee Rubber & Tire Corp.

**483 Paints—*also* see Coatings**

Pennsalt Chemicals Corp.
Reilly Tar & Chemical Corp.
Sherwin-Williams Co.
U. S. Stoneware Co.

**484 Pelletizing - Balling Equipment—does not include Sintering Equip.; Nodulizing Equip.; Briquetting Equip.**

Dravo Corp.
**HARDINGE CO., INC.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
McDowell Co., Inc., Wellman Engineering Co.
**STANDARD STEEL CORP.**

**485 Petroleum Products — *also* see Lubricants**

Atlantic Refining Co.
Esso Standard Div., Humble Oil & Refining Co.
Imperial Oil & Grease
Phillips Petroleum Co.
Sun Oil Co.
**TEXACO, INC.**

**(pH Indicators—see Meters, Chemical)**

**(Photocopy Equipment See Bluprint Machines)**

**(Picks—see Geologist's Equipment; Tools)**

**(Pipe & Tubing—see below; *also* see Electrical Conduit)**

**486 Pipe, Asbestos & Cement**

Guyan Machinery Co.
**JOHNS-MANVILLE**
Keasbey & Mattison Co.

**487 Pipe, Glass**

Corning Glass Works

**488 Pipe, Iron & Steel**

Alco Products, Inc.
American Cast Iron Pipe Co.
Armco Drainage & Metal Products
Atlas Steel, Ltd.
**BETHLEHEM STEEL CO.**
Byers, A. M., Co.
**CRUCIBLE STEEL CO. OF AMERICA**
Colorado Fuel & Iron Corp.
Durioron Co., Inc.
**ELECTRIC STEEL FOUNDRY CO.**
Foster, L. B., Co.
Jones & Laughlin Steel Corp.
**KELLOGG, M. W., CO., DIV., PULLMAN, INC.**
Metal Goods Corp.
National Supply Co.
**NAYLOR PIPE CO.**
**REPUBLIC STEEL CORP.**
Ryerson & Son, Inc.
U. S. Pipe & Foundry Co.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
**U. S. STEEL CORP., NATIONAL TUBE DIV.**
Wheeling Steel Corp.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Youngstown Sheet & Tube Co.

**489 Pipe (Metal), Non-Metallic Lined**

Armco Drainage & Metal Products
Galigher Co.
Jones & Laughlin Steel Corp.
Luzerne Rubber Co.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**U. S. STEEL CORP.**

**490 Pipe, Non-Ferrous Metal**

Ampco Metal, Inc.
Chase Brass & Copper Co.
Haynes Stellite Co., Div., Union Carbide Corp.
**INTERNATIONAL NICKEL CO.**
Metal Goods Corp.
Olds Alloy Co.
**PHELPS DODGE COPPER PRODUCTS**
Revere Copper & Brass, Inc.
Reynolds Metals Co.

### 491 Pipe, Plastic

**ACME HAMILTON MFG. CORP.**
Amercoat Corp.
American Hard Rubber Co., Div., Amerace Corp.
Byers, A. M., Co.
Carlon Products Corp.
Continental-Diamond Fibre Corp., Subsidiary Budd Co.
Evanite Plastic Co., Evans Pipe Co.
Foster, L. B., Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
Grinnell Co., Inc.
Johns-Manville Plastics Corp.
Jones & Laughlin Steel Corp.
Keasbey & Mattison Co.
Luzerne Rubber Co.
Pickard Industries, Inc., Central Mine Supply Co., Div.
**REPUBLIC STEEL CORP.**
Ryerson & Son, Inc.
Synthane Corp.
Taylor Fibre Co.
Thermoid Div., H. K. Porter Co., Inc.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
**U. S. STEEL CORP., NATIONAL TUBE DIV.**
U. S. Stoneware Co.
Weatherhead Co., Fort Wayne Div.
Youngstown Sheet & Tube Co.

### 492 Pipe, Ventilation—does not include Ventilation Tubing, Non-Metallic

Carrier Corp.
Coeur D'Alenes Co.
Foster, L. B., Co.
**JOHNS-MANVILLE**
**NAYLOR PIPE CO.**
Rockiron Co., Ltd.
Simmons Boiler & Machine Co.

### 493 Pipe, Wood

Arrow Tank Co.
Hauser-Stander Tank Co.
National Tank & Pipe Co.
Santa Fe Tank Div., Fluor Products Co.

### 494 Pipe Fittings—*also see* Pipe Line Traps; Nozzles; Valves

American Cast Iron Pipe Co.
American Hard Rubber Co., Div., Amerace Corp.
Ampco Metal, Inc.
Armco Drainage & Metal Products
**BETHLEHEM STEEL CO.**
Blaw-Knox Co.
Byers, A. M., Co.
Chase Brass & Copper Co.
Dart Union Co.
Dresser Mfg. Div., Dresser Industries, Inc.
**EASTERN SALES CO.**
**ELECTRIC STEEL FOUNDRY CO.**
Evanite Plastic Co., Evans Pipe Co.
Foster, L. B., Co.
Grinnell Co., Inc.
Gustin-Bacon Mfg. Co.
Haynes Stellite Co., Div., Union Carbide Corp.
**INTERNATIONAL NICKEL CO.**
Johns-Manville Plastics Corp.
Ladish Co.
Megator Corp.
Midwestern Engine & Equipment Co.
**NAYLOR PIPE CO.**
OPW-Jordan Corp.
Stockham Valves & Fittings
Tube Turns Div., Chemetron Corp.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
**VICTAULIC CO. OF AMERICA**
Vogt, Henry, Machine Co.
Weatherhead Co., Fort Wayne Div.

### 495 Pipeline Traps, Air, Steam & Water

Cochrane Corp.
**ERIEZ MFG. CO.**
Foster, L. B., Co.
**OHIO BRASS CO.**
Yarnall-Waring Co.

**(Pneumatic—see Air)**

**(Powder Bags—see Blasting Bags)**

**(Power Plants—see Electric Generating Power Plants)**

**(Power Shovels—see Excavators)**

### 496 Power Take-Offs—*also see* Drives

Magnetic Engineering & Mfg. Co.
Mayhew Machine & Supply Co.
Twin Disc Clutch Co.
Vickers, Inc., Tulsa Products Div.

**(Professional Services — *see* Consultants; Contractors Laboratory Service)**

**(Protective Clothing — *see* Safety Clothing)**

**(Plug Mills—see Scrubbers**

**(Pulleys—see Blocks)**

**(Pulleys, Magnetic—see Separators, Magnetic)**

### 497 Pulverizers — *also see* Crushers; Mills, Grinding

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Atlas Steel Casting Co.
**BABCOCK & WILCOX CO.**
Combustion Engineering, Inc.
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
**HARDINGE CO., INC.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Klockner-Humboldt-Deutz AG
Lippmann Engineering Works, Inc.
Majac, Inc.
**MINE & SMELTER SUPPLY CO.**
**MORSE BROS. MACHINERY CO.**
Pennsylvania Chrusher Div., Bath Iron Works Corp.
Pulva Corp.
Simmons Boiler & Machine Co.
Southwestern Engineering Co.
**STURTEVANT MILL CO.**
Universal Engineering Corp.
Whiting Corp.

### 498 Pump Accessories

Barrett Haentjens & Co.
Dean Hill corp.
Deming Co.
**FLYGT CORP.**
**INGERSOLL-RAND CO.**
Marlow Pumps Div., Bell & Gossett Co.
Megator Corp.
**MISSION MFG. CO.**
Owatonna Tool Co.
Remington Arms Co., Inc.

### 499 Pumps, Air Driven

**ACKER DRILL CO., INC.**
Boyles Bros. Drilling Co., Ltd.
**CHICAGO PNEUMATIC TOOL CO.**
Crossley Machine Co.
Gray & Co., Inc.
**INGERSOLL-RAND CO.**
Lincoln Engineering Co., Div., McNeil Machine & Engineering Co.
Marlow Pumps Div., Bell & Gossett Co.
Megator Corp.
Midwestern Engine & Equipment Co.
**STEWART-WARNER CORP., ALEMITE DIV.**
**THOR POWER TOOL CO.**
U. S. Hoffman Machinery Corp., Air Appliance Div.

### 500 Pumps, Air Lift

Carver Pump Co.
Crossley Machine Co.
**INGERSOLL-RAND CO.**

### 501 Pumps, Centrifugal & Turbine

**ALLEN-SHERMAN-HOFF PUMP CO.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Ampco Metal, Inc.
Barrett Haentjens & Co.
Buffalo Forge Co.
Byron Jackson Div., Borg-Warner Corp.
Carver Pump Co.
Chain Belt Co.
Dean Hill Corp.
Deming Co.
**DORR OLIVER, INC.**
Duriron Co., Inc.
Essick Mfg. Co.
**FAIRBANKS, MORSE & CO.**
Fairmont Machinery Co.
Flood City Brass & Elec. Co.
**FLYGT CORP.**
Galigher Co.
**GARDNER DENVER CO.**
Gorman Rupp Co.
Goulds Pumps, Inc.
Guyan Machinery Co.
Homelite Corp.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
Johnston Pump Co., Youngstown Sheet & Tube Co.
Kloeckner-Humboldt-Deutz AG
Krogh Pump & Equipment Co., Inc.
Lancaster Pump & Mfg. Co.
Lawrence Pumps, Inc.
**LINATEX CORP. OF AMERICA**
Marlow Pumps Div., Bell & Gossett Co.
**McNALLY PITTSBURG MFG. CORP.**
Midwestern Engine & Equipment Co.
**MISSION MFG. CO.**
**MORRIS MACHINE WORKS**
**MOTORAMIC INC.**
**NAGLE PUMPS, INC.**
New York Air Brake Co., Aurora Pump Div.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.
Pennsylvania Pump & Compressor Co.
Roots-Connersville Blower Div., Dresser Industries, Inc.
Solar Aircraft Co.
Stanco Mfg. Corp.
Sumo Pumps, Inc.
**U. S. STEEL CORP.**
Warren Pumps, Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**
Wheeler, C. H., Mfg. Co.
**WILFLEY, A. R., & SONS**
Wintroath Pumps Div., Worthington Corp.

**(Pumps, Concrete & Refractory—see Concrete; Refractories)**

### 502 Pumps, Corrosive Liquids

**ALLEN-SHERMAN-HOFF PUMP CO.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Ampco Metal, Inc.
Barrett Haentjens & Co.
Buffalo Forge Co.
Byron Jackson Div., Borg-Warner Corp.
Carpco Mfg., Inc.
Carver Pump Co.
Crossley Machine Co.
Dean Hill Corp.
Denver Equipment Co.
**DORR OLIVER, INC.**
Duriron Co., Inc.
**FLYGT CORP.**
Galigher Co.
Gorman Rupp Co.
Goulds Pumps, Inc.
Gray & Co., Inc.
Hack Engineering Co.
Hypro Engineering, Inc.
**INGERSOLL-RAND CO.**
Johnston Pump Co., Youngstown Sheet & Tube Co.
Kloeckner-Humboldt-Deutz AG
Krogh Pump & Equipment Co., Inc.
Lawrence Pumps, Inc.
**LINATEX CORP. OF AMERICA**
Manzel Div., Houdaille Industries, Inc.
Marlow Pumps Div., Bell & Gossett Co.
Megator Corp.
Midwestern Engine & Equipment Co.
**MORRIS MACHINE WORKS**
**NAGLE PUMPS, INC.**
National Carbon Co., Union Carbide Corp.
New York Air Brake Co., Aurora Pump Div.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.
Rice Pump & Machine Co.
Robbins & Myers, Inc.
**STEWART-WARNER CORP., ALEMITE DIV.**
U. S. Stoneware Co.
Universal Dredge Mfg. Co.

Wallace & Tiernan, Inc.
Warren Pumps, Inc.
**WESTINGHOUSE ELECTRIC CORP.**
**WILFLEY, A. R., & SONS**
Wintroath Pumps Div., Worthington Corp.

### 503 Pumps, Deep Well—*also see* Pumps, Submersible

Barnes Mfg. Co.
Byron Jackson Div., Borg-Warner Corp.
Deming Co.
**FAIRBANKS, MORSE & CO.**
Goulds Pumps, Inc.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
Johnston Pump Co., Youngstown Sheet & Tube Co.
Lancaster Pump & Mfg. Co.
Layne & Bowler Pump Co. of L. A.
Meehanite Corp.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.
Robbins & Myers, Inc.
Sumo Pumps, Inc.
**U. S. STEEL CORP.**
Wintroath Pumps Div., Worthington Corp.

### 504 Pumps, Diaphragm

Barnes Mfg. Co.
Carver Pump Co.
Chain Belt Co.
Dagley Mfg. Co.
Denver Equipment Co.
**DORR OLIVER, INC.**
Essick Mfg. Co.
Gorman Rupp Co.
Guyan Machinery Co.
**HARDINGE CO., INC.**
Homelite Corp.
Jaeger Machine Co.
**LINATEX CORP. OF AMERICA**
Manzel Div., Houdaille Industries, Inc.
Marlow Pumps Div., Bell & Gossett Co.
Midwestern Engine & Equipment Co.
**MORSE BROS. MACHINERY CO.**
Rice Pump & Machine Co.
Wallace & Tiernan, Inc.

### 505 Pumps, Dredge & Gravel —*also see* Pumps, Sand & Slime

**ALLEN-SHERMAN-HOFF PUMP CO.**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Barrett Haentjens & Co.
Buffalo Forge Co.
**ELLICOTT MACHINE CORP.**
Erie Pump & Engine Works
**GEORGIA IRON WORKS CO.**
Kansas City Hay Press
Krogh Pump & Equipment Co., Inc.
Lawrence Pumps, Inc.
**LINATEX CORP. OF AMERICA**
Meckum Engineering, Inc.
Meehanite Corp.
Midwestern Engine & Equipment Co.
**MORRIS MACHINE WORKS**
**NAGLE PUMPS, INC.**
Taylor Wharton Div., Harsco Corp.
Thomas Foundries, Inc.
**WILFLEY, A. R., & SONS**
Winter Weiss Co.

### 506 Pumps, Hydraulic Fluid

American Brake Shoe Co.
Cessna Aircraft Co.
Commerical Shearing & Stamping Co.
Galland Henning Mfg. Co., Nopak Div.
Johnston Pump Co., Youngstown Sheet & Tube Co.
Kloeckner-Humboldt-Deutz AG
Manzel Div., Houdaille Industries, Inc.
Meehanite Corp.
Oilgear Co.
Owatonna Tool Co.
Star Hydraulics, Inc.
**STEWART-WARNER CORP., ALEMITE DIV.**
Templeton, Kenly & Co.
**U. S. STEEL CORP.**
Vickers, Inc.
Warren Pumps, Inc.

### 507 Pumps, Hydraulic Ram-Type

Duff Norton Co.
Galland Henning Mfg. Co., Nopak Div.
Meehanite Corp.
Owatonna Tool Co.
Star Hydraulics, Inc.
Templeton, Kenly & Co.

### 508 Pumps, Piston & Plunger

Boyles Bros. Drilling Co., Ltd.
Crossley Machine Co.
Deming Co.
Failing, George E., Co.
Flood City Brass & Elec. Co.
Galland Henning Mfg. Co., Nopak Div.
**GARDNER DENVER CO.**
Goulds Pumps, Inc.
Gray & Co., Inc.
Hypro Engineering, Inc.
Lancaster Pump & Mfg. Co.
Ledeen Mfg. Co.
Manzel Div., Houdaille Industries, Inc.
Marlow Pumps Div., Bell & Gossett Co.
Meehanite Corp.
Megator Corp.
National Supply Co.
**U. S. STEEL CORP.**
Wallace & Tiernan, Inc.
Warren Pumps, Inc.

### 509 Pumps, Priming

Barnes Mfg. Co.
Deming Co.
Galland Henning Mfg. Co., Nopak Div.
Gorman Rupp Co.
Goulds Pumps, Inc.
Hypro Engineering, Inc.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
Lancaster Pump & Mfg. Co.
Marlow Pumps Div., Bell & Gossett Co.
**NAGLE PUMPS, INC.**
Nash Engineering Co.
National Supply Co.

**(Pumps, Reciprocating — see Pumps, Piston)**

### 510 Pumps, Rotary Displacement

**CHICAGO PNEUMATIC TOOL CO.**
Deming Co.
**FAIRBANKS, MORSE & CO.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hypro Engineering, Inc.
Meehanite Corp.
Megator Corp.
Porto Pump, Inc.
Robbins & Myers, Inc.
Roots-Connersville Blower Div., Dresser Industries, Inc.
**U. S. STEEL CORP.**
Warren Pumps, Inc.

### 511 Pumps, Sand & Slime

**ALLEN-SHERMAN-HOFF PUMP CO.**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Barrett Haentjens & Co.
Buffalo Forge Co.
Byron Jackson Div., Borg-Warner Corp.
Carpco Mfg., Inc.
**CHICAGO PNEUMATIC TOOL CO.**
Crossley Machine Co.
Dagley Mfg. Co.
Denver Equipment Co.
Erie Pump & Engine Works
**FLYGT CORP.**
Galigher Co.
**GARDNER DENVER CO.**
**GEORGIA IRON WORKS CO.**
Guyan Machinery Co.
Hack Engineering Co.
Kansas City Hay Press
Kloeckner-Humboldt-Deutz AG
Krogh Pump & Equipment Co., Inc.
Lawrence Pumps, Inc.
**LINATEX CORP. OF AMERICA**
Meckum Engineering, Inc.
Meehanite Corp.
Midwestern Engine & Equipment Co.
**MORRIS MACHINE WORKS**
**NAGLE PUMPS, INC.**
Robbins & Myers, Inc.
Taylor Wharton Div., Harsco Corp.
Thomas Foundries, Inc.
Universal Dredge Mfg. Co.
**WESTERN MACHINERY CO., WEMCO DIV.**
**WILFLEY, A. R., & SONS**

### 512 Pumps, Submersible

Barnes Mfg. Co.
Barrett Haentjens & Co.
Byron Jackson Div., Borg-Warner Corp.
**CHICAGO PNEUMATIC TOOL CO.**
Crossley Machine Co.
Deming Co.
Duriron Co., Inc.
**FAIRBANKS, MORSE & CO.**
**FLYGT CORP.**
Gorman Rupp Co.
Goulds Pumps, Inc.
Guyan Machinery Co.
Jaeger Machine Co.
Johnston Pump Co., Youngstown Sheet & Tube Co.
Kenco Pump Div., American Crucible Products Co.
Lancaster Pump & Mfg. Co.
Layne & Bowler Pump Co. of L. A.
**MACHINERY CENTER, INC.**
Meehanite Corp.
Midwestern Engine & Equipment Co.
**MORRIS MACHINE WORKS**
Motoramic Inc.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.
Robbins & Myers, Inc.
Stanco Mfg. Corp.
Sumo Pumps, Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**
Wintroath Pumps Div., Worthington Corp.

### 513 Pumps, Sump

**ALLEN-SHERMAN-HOFF PUMP CO.**
**ATLAS COPCO**
Barnes Mfg. Co.
Barrett Haentjens & Co.
Buffalo Forge Co.
Byron Jackson Div., Borg-Warner Corp.
**CHICAGO PNEUMATIC TOOL CO.**
Dean Hill corp.
Deming Co.
Denver Equipment Co.
**FAIRBANKS, MORSE & CO.**
**FLYGT CORP.**
Galigher Co.
**GARDNER DENVER CO.**
Gorman Rupp Co.
Goulds Pumps, Inc.
Hypro Engineering, Inc.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
Johnston Pump Co., Youngstown Sheet & Tube Co.
Kenco Pump Div., American Crucible Products Co.
Krogh Pump & Equipment Co., Inc.
Lancaster Pump & Mfg. Co.
Lawrence Pumps, Inc.
Layne & Bowler Pump Co. of L. A.
**LeROI DIV WESTINGHOUSE AIR BRAKE CO.**
**LINATEX CORP. OF AMERICA**
**MACHINERY CENTER, INC.**
Marlow Pumps Div., Bell & Gossett Co.
Megator Corp.
Midwestern Engine & Equipment Co.
**MORRIS MACHINE WORKS**
Motoramic Inc.
**NAGLE PUMPS, INC.**
New York Air Brake Co., Aurora Pump Div.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp.
Remington Arms Co., Inc.
Schramm, Inc.
Stanco Mfg. Corp.
**THOR POWER TOOL CO.**
Warren Pumps, Inc.
Wheeler, C. H., Mfg. Co.
Wintroath Pumps Div., Worthington Corp.

### 514 Pumps, Vacuum

Barrett Haentjens & Co.
Beach-Russ Co.
**CHICAGO PNEUMATIC TOOL CO.**
Fuller Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hevi-Duty Electric Co.
**INGERSOLL-RAND CO.**
Jaeger Machine Co.
**JOY MFG. CO.**
Kloeckner-Humboldt-Deutz AG
Nash Engineering Co.
Pennsylvania Pump & Compressor Co.
Roots-Connersville Blower Div., Dresser Industries, Inc.
Sutorbilt Corp., Fuller Co.
U. S. Hoffman Machinery Corp., Air Appliance Div.
Wheeler, C. H., Mfg. Co.

**(Pyrometers — see Meters, Temperature)**

## R

### 515 Radiation Detectors

Bausch & Lomb Optical Co., Scientific Products Div.

Canadian Aero Service, Ltd.
General Electric Co., Apparatus Sales Div.
Geophysical Instrument & Supply
Graver Water Conditioning Co., Union Tank Car Co., Div.
Moran Instrument Co.
Ohmart Corp.
Precision Radiation Instruments
Southwestern Industrial Electronics Co.
Special Instruments Laboratory, Inc.
Stratex Instrument Co.
Ultra-Violet Products, Inc.
**WESTINGHOUSE ELECTRIC CORP.**

**(Radio—see Communications)**

### 516 Rail Benders

**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
**NATIONAL MINE SERVICE CO.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 517 Rail Bonds

**AMERICAN MINE DOOR CO.**
Flood City Brass & Elec. Co.
Foster, L. B., Co.
Frank, M. K.
**NATIONAL MINE SERVICE CO.**
**OHIO BRASS CO.**
Penn Machine Co.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 518 Rail Braces

**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
Nolan Co.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 519 Rail Clamps, Fish-Plates, Tie-Plates & Frogs

**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Colorado Fuel & Iron Corp.
Foster, L. B., Co.
Frank, M. K.
Pettibone Mulliken Corp.
Taylor Wharton Div., Harsco Corp.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 520 Rail Drills & Punches

Foster, L. B., Co.
Frank, M. K.
**NORDBERG MFG. CO.**
**OHIO BRASS CO.**
Remington Arms Co., Inc.

### 521 Rail Signals—*also* see Communications

**AMERICAN MINE DOOR CO.**
Foster, L. B., Co.
Frank, M. K.
**NACHOD & U. S. SIGNAL CO.**
Union Switch & Signal, Westinghouse Air Brake Co.
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 522 Rail Spikes

**BETHLEHEM STEEL CO.**
Colorado Fuel & Iron Corp.
Foster, L. B., Co.
Frank, M. K.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Youngstown Sheet & Tube Co.

### 523 Rail Switch Throwers

**AMERICAN MINE DOOR CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
**CHEATHAM ELECTRIC SWITCHING DEVICE CO.**
Foster, L. B., Co.
Frank, M. K.
Union Switch & Signal, Westinghouse Air Brake Co.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 524 Rail Switches & Crossings

American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
Pettibone Mulliken Corp.
Sorel Steel Foundries, Ltd.
Taylor Wharton Div., Harsco Corp.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 525 Rail Ties, Steel

**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Foster, L. B., Co.
Frank, M. K.
Rockiron Co., Ltd.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 526 Rail & Track

**BETHLEHEM STEEL CO.**
Colorado Fuel & Iron Corp.
Foster, L. B., Co.
Frank, M. K.
**MORSE BROS. MACHINERY CO.**
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 527 Rail & Track Accessories —*also* see specific item under Car . . . Rail . . . or Track

American Brake Shoe Co.
**AMERICAN MINE DOOR CO.**
**BETHLEHEM STEEL CO.**
Byers, A. M., Co.
**CARD, C. S., IRON WORKS**
Colorado Fuel & Iron Corp.
Foster, L. B., Co.
Frank, M. K.
**MAYO TUNNEL & MINE EQUIPMENT**
Nalco Chemical Co.
National Lock Washer Co.
Nolan Co.
**OHIO BRASS CO.**
Pettibone Mulliken Corp.
Sheffield Div., Armco Steel Corp.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

**(Reagent Feeders—see Feeders)**

**(Reagents — see Chemicals; Flotation Reagents; Water Clarification Chemicals)**

**(Rectifiers—see Electric Rectifiers)**

**(Refractories—see below; *also* see Insulation; Furnace Linings)**

### 528 Refractories, Brick

**BABCOCK & WILCOX CO.**
Bay State Abrasvie Products Co.
Bigelow-Liptak Corp.
Denver Fire Clay Co.
Gladding, McBean & Co.
Green Fire Brick Co.
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc.
National Carbon Co., Union Carbide Corp.
Norton Co.
Robinson Clay Product Co.
Walsh Refractories Corp.

### 529 Refractories, Castable

**BABCOCK & WILCOX CO.**
Bigelow-Liptak Corp.
Denver Fire Clay Co.
Gladding, McBean & Co.
Green Fire Brick Co.
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc.
Norton Co.
Robinson Clay Product Co.
Spang & Co.
Walsh Refractories Corp.

### 530 Refractory Cement

**BABCOCK & WILCOX CO.**
Bay State Abrasive Products Co.
Bigelow-Liptak Corp.
Carey, Philip, Mfg. Co.
Denver Fire Clay Co.
Eagle-Picher Co.
Engelhard Industries Inc.
Gladding, McBean & Co.
Green Fire Brick Co.
**HALLIBURTON OIL WELL CEMENTING**
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refactories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc.
Norton Co.
Robinson Clay Products Co.
Spang & Co.
**U. S. STEEL CORP.**
Walsh Refractories Corp.

### 531 Refractory Material Other Than Above

**BABCOCK & WILCOX CO.**
Denver Fire Clay Co.
Gladding, McBean & Co.
Godoy, E. A., & Co., Inc.
Green Fire Brick Co.
**HARBISON-WALKER REFRACTORIES CO.**
**JOHNS-MANVILLE**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc.
Laboratory Equipment Corp.
National Carbon Co., Union Carbide Corp.
Norton Co.
Pittsburgh Corning Corp.
Robinson Clay Product Co.
Rockiron Co., Ltd.
Walsh Refractories Corp.

### 532 Refractory Placers, Sprayers, Pumps & Blowers—*also* see Concrete Pumps

Cement Gun Co.
Crossley Machine Co.
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc.

**(Respirators—see Safety Respirators)**

### 533 Retorts & Distillation Process Equipment, Liquid,—does not include Boilers; Laboratory Equipment.

Vulcan-Cincinnati, Inc.

### 534 Retorts & Distillation Process Equipment, Solid —*also* see Furnaces; Kilns; does not include Laboratory Equipment

**GENERAL AMERICAN TRANSPORTATION CORP.**
**GOULD, GORDON I., CO.**

### 535 Rock (& Roof) Bolt Accessories

**BETHLEHEM STEEL CO.**
Bitco, Inc.
Colorado Fuel & Iron Corp.
Commercial Shearing & Stamping Co.
**INGERSOLL-RAND CO.**
**OHIO BRASS CO.**
Pattin Mfg. Co.
**REPUBIC STEEL CORP.**
Rockiron Co., Ltd.
Thompson, Ramo-Wooldridge, Inc., Valve Div.
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 536 Rock (& Roof) Bolts

**ALIMAK CORP.**
**BETHLEHEM STEEL CO.**
Bitco, Inc.
Colorado Fuel & Iron Corp.
Commercial Shearing & Stamping Co.
**OHIO BRASS CO.**
Pattin Mfg. Co.
**REPUBLIC STEEL CORP.**
Rockiron Co., Ltd.
Sika Chemical Corp.
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Youngstown Sheet & Tube Co.

### 537 Roof Bolting Machines

**CHICAGO PNEUMATIC TOOL CO.**
**INGERSOLL-RAND CO.**
Jeffrey Mfg. Co.
**JOY MFG. CO.**
Long-Airdox Co., Marmon-Herrington, Inc.
Penn Machine Co.

### 538 Roofing & Siding, Metal

National Lock Washer Co.
**INTERNATIONAL NICKEL CO.**
Aluminum Co. of America
**BETHLEHEM STEEL CO.**
Butler Mfg. Co.
Chase Brass & Copper Co.
Plasteel Products Co.
**REPUBLIC STEEL CORP.**
Reynolds Metals Co.
Ryerson & Son, Inc.
**U. S. STEEL CORP.**
Wheeling Steel Corp.

### 539 Roofing & Siding, Non-Metallic

Carey, Philip, Mfg. Co.
**JOHNS-MANVILLE**
Keasbey & Mattison Co.
Koppers Co., Inc.
Rockiron Co., Ltd.
Ruberoid Co.

### 540 Rope & Twine (Hemp, Et Al)—does not include Wire Rope

Flocker, John, & Co.
**JOHNS-MANVILLE**

**(Rust Preventives—see Coatings)**

# S

### 541 Safety Clothing, Gloves, Hats, Belts, Shoes, etc.

American Optical Co., Safety Products Div.
Bausch & Lomb Optical Co., Scientific Products Div.
Bullard, E. D., Co.
Filtration Engineers Div., American Machine & Metals, Inc.
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
Hood Industrial Gloves
Industrial Air Products Co.
Miller Equipment Co., Inc.
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
Pulmosan Safety Equipment Corp.
Ray-O-Vac Co.
Russell Mfg.
Safety Clothing & Equipment Co.
Safety First Supply Co.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Wilson Rubber Co., Becton, Dickinson & Co.
Worklon, Inc.

### 542 Safety Equipment & Accessories—does not include Dust Samplers; Safety Clothing; Safety Goggles & Masks; Safety Posters; Safety Respirators. *Also see* Fire Fighting; First Aid; Meters

American Optical Co., Safety Products Div.
Beryllium Corp.
Bullard, E. D., Co.
Chicago Eye Shield Co.
Cutler-Hammer, Inc.
Falcon Alarm Co., Inc.
Hammond, J. V., Co.
Harrington Co.
**LOGAN ENGINEERING CO.**
**MACHINERY CENTER, INC.**
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
**OHIO BRASS CO.**
Pulmosan Safety Equipment Corp.
Ray-O-Vac Co.
Safety First Supply Co.
Scott Aviation Corp.
Willson Products Div., Ray-O-Vac Co.

### 543 Safety Goggles & Masks

American Optical Co., Safety Products Div.
Bausch & Lomb Optical Co., Scientific Products Div.
Bullard, E. D., Co.
Chicago Eye Shield Co.
Geophysical Instrument & Supply
Industrial Air Products Co.
Lincoln Electric Co.
Marquette Mfg. Co., Inc.
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
Pulmosan Safety Equipment Corp.
Ray-O-Vac Co.
Safety First Supply Co.
Welsh Mfg. Co.
Willson Products Div., Ray-O-Vac Co.

**(Safety Posters—see Signs)**

### 544 Safety Respirators

American Optical Co., Safety Products Div.
Chicago Eye Shield Co.
Flexo Products, Inc.
Fyr-Fyter Co.
Industrial Air Products Co.
**MINE SAFETY APPLIANCES CO.**
**NATIONAL MINE SERVICE CO.**
Pulmosan Safety Equipment Corp.
Ray-O-Vac Co.
Safety First Supply Co.
Scott Aviation Corp.
Welsh Mfg. Co.
Willson Products Div., Ray-O-Vac Co.

### 545 Sampling Devices, Ore, Concentrate, etc. (Mechanical)—does not include Meters

Carpco Mfg. Inc.
Dagley Mfg. Co.
Denver Equipment Co.
Galigher Co.
Gilson Screen Co.
**HARDINGE CO., INC.**
Kloeckner-Humboldt-Deutz AG
**MINE & SMELTER SUPPLY CO.**
OPW-Jordan Corp.

**(Saws—see below; *also see* Tools)**

### 546 Saws & Channelers; Rock, Concrete & Masonry

Bay State Abrasive Products Co.
Engineered Equipment, Inc.
Norton Co.
Porter-Cable Machine Co.
**WHEEL TRUEING TOOL CO.**

**(Scales, see below—*also see* Meters)**

### 547 Scales, Automatic Weighing — *also see* Feeders

B-I-F Industries, Inc.
**BEMIS BROS. BAG CO.**
Buffalo Scale Co., Inc.
Erie Strayer Co.
**FAIRBANKS, MORSE & CO.**
Howe Scale Co., American Mfg. Co., Inc.
**INDUSTRIAL PHYSICS & ELECTRONICS**
McDowell Co., Inc., Wellman Engineering Co.
**MERRICK SCALE MFG. CO.**
Moran Instrument Co.
Revere Corp. of America, Neptune Meter Co.
Richardson Scale Co.
Schaffer Poidometer Co.
Streeter-Amet Co.
Thayer Scale
Thurman Scale Co.
Toledo Scale, Toledo Scale Corp.
Trans-Weigh Corp.
Wallace & Tiernan, Inc.

### 548 Scales, Belt Conveyor

B-I-F Industries, Inc.
Howe Scale Co., American Mfg. Co., Inc.
**INDUSTRIAL PHYSICS & ELECTRONICS**
McDowell Co., Inc., Wellman Engineering Co.
**MERRICK SCALE MFG. CO.**
Streeter-Amet Co.
Thayer Scale
Thurman Scale Co.
Trans-Weigh Corp.
Wallace & Tiernan, Inc.
**WESTERN CONVEYOR CO.**

### 549 Scales, Platform

Buffalo Scale Co., Inc.
**FAIRBANKS, MORSE & CO.**
Howe Scale Co., American Mfg. Co., Inc.
Streeter-Amet Co.
Thurman Scale Co.
Toledo Scale, Toledo Scale Corp.

### 550 Scales, Sacking

**FAIRBANKS, MORSE & CO.**
Howe Scale Co., American Mfg. Co., Inc.
Manning, Maxwell & Moore, Inc., Shaw Box Crane & Hoist Div.
Richardson Scale Co.
Thayer Scale
Thurman Scale Co.
Toledo Scale, Toledo Scale Corp.

### 551 Scales, Weigh Hopper—*also see* Feeders

**ATLAS CAR & MFG. CO.**
Buffalo Scale Co., Inc.
Engineered Equipment, Inc.
**FAIRBANKS, MORSE & CO.**
Geo Optic & Paper Corp.
Howe Scale Co., American Mfg. Co. Inc.
**INDUSTRIAL PHYSICS & ELECTRONICS**
Richardson Scale Co.
Streeter-Amet Co.
Thayer Scale
Thurman Scale Co.
Toledo Scale, Toledo Scale Corp.
**WESTERN CONVEYOR CO.**

**(Scientific Instruments—see Laboratory & Scientific Instruments; Chemical Lab. Equip.; Meters; Geophysical Instruments; Spectroscopic Instruments; Drafting Equip.; Surveying Equip.)**

**(Scintillation Counters—see Radiation Dectors)**

**(Scrapers, Dragline — see Buckets, Dragline Scraper-Slusher; Hoists, Dragline Scraper-Slusher; Excavators, Dragline Tower)**

### 552 Scrapers, Wheeled, Self-Propelled & Towing (Earthmoving)

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Case, J. I., Co., Industrial Div.
**CATERPILLAR TRACTOR CO.**

**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV.**
**DEERE & CO.**
**EUCLID DIV., GENERAL MOTORS CORP.**
Greenville Steel Car Co.
**LeTROUNEAU, INC.**
**LeTOURNEAU-WESTINGHOUSE CO.**
Midwestern Engine & Equipment Co.
Oliver Corp.
Sheffield Div., Armco Steel Corp.

**(Scientific Instruments—*see* Laboratory & Scientific Instruments; Chemical Lab. Equip.; Meters; Geophysical Instruments; Spectroscopic Instruments; Drafting Equip.; Surveying Equip.)**

**(Scintillation Sounters — *see* Radiation Detectors)**

**(Screen Cloth — *see* Wire Cloth)**

### 553 Screen Eccentrics & Vibrators—*also see* Vibrators

Derrick Mfg. Co.
Diamond Iron Works Div., Goodman Mfg. Co.
Hack Engineering Co.
**HENDRICK MFG. CO.**
**LINK-BELT CO.**
Midwestern Engine & Equipment Co.
**MORSE BROS. MACHINERY CO.**
Ridge Equipment Co.
Smith Engineering Works
Southwestern Engineering Co.
Stephens-Adamson Mfg. Co.
**TYLER, W. S., CO.**
Universal Dredge Mfg. Co.
Viber Co.

### 554 Screen Heaters

**LINK-BELT CO.**
Overstrom & Sons, Inc.
Southwestern Engineering Co.
**TYLER, W. S., CO.**

### 555 Screen Plates & Sheet

Chicago Perforating Co.
Fairmont Machinery Co.
**HENDRICK MFG. CO.**
Laubenstein Mfg. Co.
**LINK-BELT CO.**
**McNALLY PITTSBURG MFG. CORP.**
National Standard Co.
Taylor Wharton Div., Harsco Corp.

### 556 Screen, Wire & Bar

**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Bixby-Zimmer Engr. Co.
Colorado Fuel & Iron Corp.
**HENDRICK MFG. CO.**
Hoyt Wire Cloth Co.
**LINK-BELT CO.**
Manganese Steel Forge Co.
**McNALLY PITTSBURGH MFG. CORP.**
Multi-Metal Wire Cloth Co., Inc.
National Standard Co.
Newark Wire Cloth Co.
Southwestern Engineering Co.
Star Wire Screen & Iron Works, Inc.
Taylor Wharton Div., Harsco Corp.
**TYLER, W. S., CO.**
**U. S. STEEL CORP.**
**WEDGE WIRE CORP.**

### 557 Screens, Electrically Heated

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**DEISTER CONCENTRATOR CO.**
**DEISTER MACHINE CO.**
**HEWITT-ROBINS, INC.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works, Inc.
Overstrom & Sons, Inc.
Productive Equipment Corp.
Southwestern Engineering Co.
**TYLER, W. S., CO.**
Universal Vibrating Screen Co.

### 558 Screens, Gravity

Bixby-Zimmer Engr. Co.
Chicago Perforating Co.
**DORR OLIVER, INC.**
**HENDRICK MFG. CO.**
**LINK-BELT CO.**
Lippmann Engineering Works, Inc.
Newark Wire Cloth Co.
**TYLER, W. S., CO.**
Universal Engineering Corp.
**WEDGE WIRE CORP.**

### 559 Screens, Revolving (Trommel)

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Bixby-Zimmer Engr. Co.
Bodinson Mfg. Co., Inc.
Chicago Perforating Co.
Davis Foundry & Machine Works
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hack Engineering Co.
**HENDRICK MFG. CO.**
Kloeckner-Humboldt-Deutz AG
Laubenstein Mfg. Co.
**LINK-BELT CO.**
Lippmann Engineering Works, Inc.
**McLANAHAN & STONE CORP.**
Multi-Metal Wire Cloth Co., Inc.
Newark Wire Cloth Co.
Pioneer Engineering Div., Poor & Co., Inc.
Smith Engineering Works
Stephens-Adamson Mfg. Co.
**TYLER, W. S., CO.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Universal Road Machinery Co.
**WEDGE WIRE CORP.**
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 560 Screens, Shaking & Vibrating

Ajax Flexible Coupling Co.
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Bixby-Zimmer Engr. Co.
Bodinson Mfg. Co., Inc.
Bonded Scale & Machine Co.
Cambridge Wire Cloth Co.
Chain Belt Co.
Chicago Perforating Co.
Crossley Machine Co.
Davis Foundry & Machine Works
**DEISTER CONCENTRATOR CO.**
**DEISTER MACHINE CO.**
Denver Equipment Co.
Derrick Mfg. Co.
Diamond Iron Works Div., Goodman Mfg. Co.
**DIESEL ENERGY CORP.**
**DRAVO CORP.**
Exolon Co.
Fairmont Machinery Co.
Gilson Screen Co.
Hack Engineering Co.
**HENDRICK MFG. CO.**
**HEWITT-ROBINS, INC.**
Industrial Engineering & Construction Co.
**IOWA MFG. CO.**
Jeffrey Mfg. Co.
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Lippmann Engineering Works, Inc.
Meckum Engineering, Inc.
Multi-Metal Wire Cloth Co., Inc.
Newark Wire Cloth Co.
**NORDBERG MFG. CO.**
Overstrom & Sons, Inc.
Pioneer Engineering Div., Poor & Co., Inc.
Productive Equipment Corp.
Screen Equipment Co., Inc.
Simplicity Engineering Co.
Smith Engineering Works
Southwestern Engineering Co.
Star Wire Screen & Iron Works Inc.
**STURTEVANT MILL CO.**
Sutton Steele & Steele Inc.
**TYLER, W. S., CO.**
Universal Dredge Mfg. Co.
Universal Engineering Corp.
**WEDGE WIRE CORP.**
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**

### 561 Scrubbers, Air & Waste Gas—*also see* Dust Collectors; Gas Separation Process Equipment

Aerotec Industries, Inc.
Arrow Tank Co.
Chemical Construction Corp.
**DORR OLIVER, INC.**
**DUCON CO., INC.**
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Hauser-Stander Tank Co.
Kloeckner-Humboldt-Deutz AG
Multi-Metal Wire Cloth Co., Inc.
Oxy-Catalyst Inc.
Research-Cottrell, Inc.
Universal Vibrating Screen Co.
Vulcan-Cincinnati Inc.
**WESTERN PRECIPITATION DIV., JOY MFG. CO.**

**(Scrubbers, Engine Exhaust—*see* Engine Exhaust Scrubbers)**

### 562 Scrubbers & Washers, Mineral—*also see* Agitators, Washing Plants

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bodinson Mfg. Co., Inc.
Booth Co., Inc.
Chemical Construction Corp.
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**DORR OLIVER, INC.**
Eagle Iron Works
**GENERAL AMERICAN TRANSPORTATION CORP.**
**GEORGIA IRON WORKS CO.**
**HARDINGE CO., INC.**
**IOWA MFG. CO.**
**KENNEDY VAN SAUN MFG. & ENG. CORP.**
Kloeckner-Humboldt-Deutz AG
Link-Belt Co.
Lippmann Engineering Works Inc.
Magnetic Engineering & Mfg. Co.
**McLANAHAN & STONE CORP.**
**MINE & SMELTER SUPPLY CO.**
**MIXING EQUIPMENT CO.**
Pioneer Engineering Div., Poor & Co., Inc.
Smith Engineering Works
Universal Engineering Corp.
Universal Road Machinery Co.
Vulcan-Cincinnati, Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 563 Separators (Ore), Electrostatic & High Tension

Carpco Mfg., Inc.
**DINGS MAGNETIC SEPARATOR CO.**
Exolon Co.
Magnetic Engineering & Mfg. Co.
Stearns Magnetic Products
**WESTINGHOUSE ELECTRIC CORP.**

### 564 Separators (Ore), Heavy Media Type—for recovery of media alone, *see* Heavy Media Recovery Units

Derrick Mfg. Co.
**DIESEL ENERGY CORP.**
**DINGS MAGNETIC SEPARATOR CO.**
**DORR OLIVER, INC.**
Eagle Iron Works
**HARDINGE CO., INC.**
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
Link-Belt Co.
Magnetic Engineering & Mfg. Co.
**MINE & SMELTER SUPPLY CO.**
Ore & Chemical Corp.
Southwestern Engineering Co.
Stearns Magnetic Products
**STEARNS ROGER MFG. CO.**
**WESTERN MACHINERY CO., WEMCO DIV.**

### 565 Separators (Ore), Jig, Dry

Bico, Inc.
**DIESEL ENERGY CORP.**

Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Overstrom & Sons, Inc.
Ridge Equipment Co.

### 566 Separators (Ore), Jig Wet

Davis Foundry & Machine Works
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**DORR OLIVER, INC.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**McLANAHAN & STONE CORP.**
Meckum Engineering, Inc.
**WESTERN MACHINERY CO., WEMCO DIV.**

**(Self-Loading Transports — *see* Scrapers; Cars, Mine RR; Trucks; Loaders)**

**(Separators & Concentrators Ore—see below; *also see* Amalgamating Process Equipment (special); Asbestos Milling Equipment (special); Classifiers; Cyaniding; Process Equipment (special); Diamond Concentrating Equipment (special); Filters; Flotation Machines; Gas Separation Equipment (special); Ion Exchange Equipment (special); Kilns; Retorts and Distillation Equipment; Screens; Scrubbers; Solvent Extraction Equipment (special); Thickeners)**

### 567 Separators (Ore), Magnetic, Belt & Drum

Carpco Mfg., Inc.
**DIESEL ENERGY CORP.**
**DINGS MAGNETIC SEPARATOR CO.**
**ERIEZ MFG. CO.**
Jeffrey Mfg. Co.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Magnetic Engineering & Mfg. Co.
Research-Cottrell, Inc.
Stearns Magnetic Products

### 568 Separators (Ore), Shaking Table, Dry (Air)

**DIESEL ENERGY CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
Roberts & Schaefer Co., Div. Thompson-Starrett Co., Inc.
Sutton Steele & Steele, Inc.

### 569 Separators (Ore), Shaking Table, Wet

Dagley Mfg. Co.
**DEISTER CONCENTRATOR CO.**
**DEISTER MACHINE CO.**
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MINE & SMELTER SUPPLY CO.**

### 570 Separators (Ore), Sluice (Trough) Spiral & Similar Film Gravity Types

Cannon Concentrator
**DIESEL ENERGY CORP.**
Hack Engineering Co.
Humphreys Engineering Co.
**LINK-BELT CO.**
Universal Dredge Mfg. Co.

**(Shaft Mucking Machines—*see* Loaders, Special Mine Shaft Mucking)**

**(Sheaves—see below; *also see* Blocks)**

### 571 Sheaves, Mine Hoist

**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
**AMERICAN HOIST & DERRICK CO.**
**BETHLEHEM STEEL CO.**
**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Guyan Machinery Co.
**HEWITT-ROBINS, INC.**
Lake Shore, Inc., Lake Shore Engineering Div.
**MAYO TUNNEL & MINE EQUIPMENT**
McDowell Co., Inc., Wellman Engineering Co.
**NAT'L. MALLEABLE & STEEL CASTINGS CAPITOL FOUNDRY DIV.**
**NORDBERG MFG. CO.**
Ogden Iron Works Co.
Penn Machine Co.
Pittsburgh Gear Co.
Round & Son, Inc.
Sanford-Day Iron Works, Inc.
Stroh Process Steel Co.
Taylor Wharton Div., Harsco Corp.
Tool Steel Gear & Pinion Co.
**VULCAN IRON WORKS CO.**
Washington Iron Works

### 572 Shop Equipment, Machine, Fabricating & Repair, Powered (Lathes, Presses, etc.)—does not include Blast Cleaning Equipment; Conveyor Belting Vulcanizers; Cranes; Drill Bit & Steel Forging Hammers; Electric Cable Splicers & Vulcanizers; Forgers; Furnaces; Grinders & Buffers; Hoists; Lift; Metallizing Equipment; Timber Framing Machines; Tools, Hand & Power; Welding & Cutting Equip.; Steam Clean Equip.

Black's Machine Shop
Buffalo Forge Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Firth Sterling, Inc.
Guyan Machinery Co.
Owatonna Tool Co.
Porter-Cable Machine Co.
Ridge Tool Co.
Snap-on-Tools Corp.
South Bend Lathe, Inc.

**(Shovels — *see* Excavators, Tools)**

**(Sieves—see below; *also see* Screens)**

**(Shuttle Cars—*see* Trucks, Shuttle Car)**

### 573 Sieves, Testing

Derrick Mfg. Co.
Gilson Screen Co.
Laubenstein Mfg. Co.
Newark Wire Cloth Co.
**TYLER, W. S., CO.**

**(Signals — *see* Communications)**

### 574 Signs—Posters

Aluminum Co. of America
Brady, W. H., Co.
Filtration Engineers Div., American Machine & Metals, Inc.
**NATIONAL MINE SERVICE CO.**

### 575 Sintering Equipment (Special)—does not include Furnaces; Kilns; Nodulizing Equipment

**DRAVO CORP.**
**GOULD, GORDON I., CO.**
McDowell Co., Inc., Wellman Engineering Co.
**NAT'L MALLEABLE & STEEL CASTINGS CAPITOL FOUNDRY DIV.**

### 576 Skiphoists—*see* Hoists

**CONNELLSVILE MFG. & MINE SUPPLY**
**HEWITT-ROBINS, INC.**
Jeffrey Mfg. Co.
Lake Shore, Inc., Lake Shore Engineering Div.
Lidgerwood Mfg. Co.
**LINK-BELT CO.**
Manning, Maxwell & Moore, Inc., Shaw Box Crane & Hoist Div.
**MAYO TUNNEL & MINE EQUIPMENT**
**NATIONAL IRON CO.**
Shepard Niles Crane & Hoist Corp.
Superior-Lidgerwood-Mundy Corp.

### 577 Skips & Cages (Mine Hoist)—does not include Buckets, Hoisting & Sinking

**CARD, C. S., IRON WORKS**
Coeur D'Alenes Co.
**CONNELLSVILLE MFG. & MINE SUPPLY**
Denver Equipment Co.
Lake Shore, Inc., Lake Shore Engineering Div.
Lidgerwood Mfg. Co.
**MAYO TUNNEL & MINE EQUIPMENT**
Nolan Co.
Ogden Iron Works Co.
Roberts & Schaefer Co. Div., Thompson-Starrett Co., Inc.
Stephens-Adamson Mfg. Co.
**VULCAN IRON WORKS CO.**

**(Slushers—*see* Buckets, Dragline Scraper-Slusher; Hoists, Dragline Scraper-Slusher; Loaders; Excavators)**

### 578 Solenoids, Electric

Allen-Bradley Co.
Automatic Switch Co.
Cutler-Hammer, Inc.
General Electric Co., Apparatus Sales Div.
OPW-Jordan Corp.
Rockiron Co., Ltd.
Vickers, Inc., Electric Products Div.
**WESTINGHOUSE ELECTRIC CORP.**

### 579 Solvent Extraction Process Equipment (Special)—does not include standard auxiliary equipment—*also see* Ion Exchange; Solvent Extraction; Cyaniding; Amalgamating; Electrolytic

Blaw-Knox Co.
Chemical Separations Corp.
Denver Equipment Co.
**MIXING EQUIPMENT CO.**
Rohm & Haas Co.
**STEARNS ROGER MFG. CO.**
Vulcan-Cincinnati, Inc.

### 580 Spectroscopic Instruments

Bausch & Lomb Optical Co., Scientific Products Div.
Beckman Instrument, Inc., Scientific Process Instruments Div.
Fisher Scientific Co.
General Electric Co., Apparatus Sales Div.

**(Speed Reducers & Increasers —*see* Drives)**

**(Sprockets—*see* Gears)**

**(Stackers — see Conveyors; Cranes)**

### 581 Steam Cleaning Equipment

Clayton Mfg. Co.
Cochrane Corp.

### 582 Steel (Plates, Shapes, etc.)—does not include Building, Prefab; Castings; Drill Steel; Forgings; Fencing; Mine Supports; Pipe; Screen; Tank; Wire

Alan Wood Steel Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Armco Steel Corp.
Atlas Steels, Ltd.
**BETHLEHEM STEEL CO.**
Butler Mfg. Co.
Byers, A. M., Co.
Colorado Fuel & Iron Corp.
**CRUCIBLE STEEL CO. OF AMERICA**
Firth Sterling, Inc.
Foster, L. B., Co.
Jones & Laughlin Steel Corp.
Lukens Steel Co.
Metal Goods Corp.
**REPUBLIC STEEL CORP.**
Ryerson & Son, Inc.
Sheffield Div., Armco Steel Corp.
Sorel Steel Foundries, Ltd.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
West Virginia Works, Connors Steel Div., H. K. Porter Co. Inc.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Youngstown Sheet & Tube Co.

### 583 Steel, Alloy (Plates, Shapes, etc.)—does not include Castings; Drill Steel; Forgings; Mine Supports; Pipe; Screen; Tanks; Wire—*also see* Linings

Alan Wood Steel Co.
Armco Steel Corp.
Atlas Steels, Ltd.
**BETHLEHEM STEEL CO.**
Byers, A. M., Co.
Colorado Fuel & Iron Corp.
**CRUCIBLE STEEL CO. OF AMERICA**
Firth Sterling, Inc.
Jones & Laughlin Steel Corp.
**KELLOGG, M. W., CO. DIV., PULLMAN INC.**
Lukens Steel Co.
Manganese Steel Forge Co.
Metal Goods Corp.
**REPUBLIC STEEL CORP.**
Rockiron Co., Ltd.
Ryerson & Son, Inc.
Sheffield Div., Armco Steel Corp.
Sorel Steel Foundries, Ltd.
**TIMKEN ROLLER BEARING CO.**
**U. S. FOUNDRIES, INC.**
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP.**
Youngstown Sheet & Tube Co.

### 584 Steel Fabricators — see Contractors

Alco Products, Inc.
American Bridge Div., U. S. Steel Corp.
Arrowhead Steel Buildings, Inc.
Bitco, Inc.
Blaw-Knox Co.
Coeur D'Alenes Co.
Combustion Engineering, Inc.
Commercial Shearing & Stamping Co.
Dresser-Ideco Co.
Enterprise Wheel & Car Corp.
Fairmont Machinery Co.
Foster, L. B., Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Industrial Engineering & Construction Co.
Lakeside Bridge & Steel Co.
Lukens Steel Co.
McDowell Co., Inc., Wellman Engineering Co.
Meckum Engineering, Inc.
Midwestern Engine & Equipment Co.
Ogden Iron Works Co.
Rockiron Co., Ltd.
Smith Engineering Works
Southwestern Engineering Co.
**STEARNS ROGER MFG. CO.**

**(Steel Mine Supports & Circular Sets—see Mine Supports)**

### 585 Steel, Stainless (Plates, Shapes, etc.)—does not include Castings; Forgings; Mine Supports; Pipe; Screen; Tanks; Wire

Allegheny Ludlum Steel Corp.
Armco Steel Corp.
Atlas Steels, Ltd.
Byers, A. M., Co.
Chase Brass & Copper Co.
Colorado Fuel & Iron Corp.
**CRUCIBLE STEEL CO. OF AMERICA**
Firth Sterling, Inc.
Metal Goods Corp.
**REPUBLIC STEEL CORP.**
Rockiron Co., Ltd.
Ryerson & Son, Inc.
**TIMKEN ROLLER BEARING CO.**
**U. S. STEEL CORP.**
**U. S. STEEL CORP. COLUMBIA-GENEVA STEEL DIV.**

**(Stowers — see Concrete Pumps & Placers)**

### 586 Stud Drivers

**MINE SAFETY APPLIANCES CO.**
Remington Arms Co., Inc.

**(Sulphur Well Equipment—see Salt & Sulphur)**

### 587 Surveying Equipment & Supplies—*also see* Drafting Equipment & Supplies; Transits, Pocket

AGA Corp. of America
American Paulin System
Exploration Methods, Inc.
Geodimeter Co.
Geo. Optic & Paper Corp.
Geophysical Instrument & Supply
Gurley, W. & L. E.
Kern Instruments, Inc.
Frederick Post Co.
Stratex Instrument Co.
Wallace & Tiernan, Inc.
Warren-Knight Co.
White, David, Instruments Realist, Inc.
**WILD HEERBRUGG INSTRUMENTS, INC.**

**(Surveyors—see Contractors)**

## T

**(Tables — see Separators & Concentrators)**

**(Tachometers — see Meters, Speed)**

**(Tank Level Indicators—see Bin & Tank Level Indicators)**

### 588 Tanks, Lined—see below; *also see* Coatings; Linings

Arrow Tank Co.
Cement Gun Co.
Crossley Machine Co.
Denver Equipment Co.
Eastern Steel Plate Fabricators, Inc.
Galigher Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
Hauser-Stander Tank Co.
**LINATEX CORP. OF AMERICA**
Luzerne Rubber Co.
Rail & Industrial Equipment Co., Inc.
U. S. Stoneware Co.

### 589 Tanks, Lined, Ceramic, Concrete, Glass, etc.

Cement Gun Co.
Eastern Steel Plate Fabricators, Inc.
Galigher Co.
Pennsalt Chemicals Corp.
Rail & Industrial Equipment Co., Inc.
U. S. Stoneware Co.

### 590 Tanks, Lined, Plastic, Rubber, etc.

American Hard Rubber Co., Div. Amerace Corp.
Arrow Tank Co.
Denver Equipment Co.
Eastern Steel Plate Fabricators, Inc.
Galigher Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Goodall Rubber Co.
**GOODRICH, B. F., INDUSTRIAL PRODS. CO.**
**GOODYEAR TIRE & RUBBER CO.**
Hauser-Stander Tank Co.
**LINATEX CORP. OF AMERICA**
Luzerne Rubber Co.
Rail & Industrial Equipment Co., Inc.
U. S. Stoneware Co.

### 591 Tanks, Lined, Special Metal

Arrow Tank Co.
Combustion Engineering, Inc.
Eastern Steel Plate Fabricators, Inc.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Pacific Coast Engineering Co.

### 592 Tanks, Steel—*also see* Bins

ACF Industries, Inc., American Car & Foundry Div.
**BETHLEHEM STEEL CO.**
Bodison Mfg. Co., Inc.
Butler Mfg. Co.
Chicago Bridge & Iron Co.
Colorado Fuel & Iron Corp.
Crossley Machine Co.
Davis Foundry & Machine Works
Denver Equipment Co.
Eastern Steel Plate Fabricators, Inc.
Enterprise Wheel & Car Corp.
Fairmont Machinery Co.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Industrial Engineering & Construction Co.
Keeler, E., Co.
Kloeckner-Humboldt-Deutz AG
Lancaster Pump & Mfg. Co.
Ogden Iron Works Co.
Parkersburg Rig & Reel Co.
Rail & Industrial Equipment Co., Inc.
Rockiron Co., Ltd.
Simmons Boiler & Machine Co.
Southwestern Engineering Co.
**STEARNS ROGER MFG. CO.**
**U. S. STEEL CORP.**
**WESTERN CONVEYOR CO.**

### 593 Tanks, Wood—*also see* Bins

Arrow Tank Co.
Crossley Machine Co.
Denver Equipment Co.
Hauser-Stander Tank Co.
National Tank & Pipe Co.
Pacific Wood Tank Div., Sauers Forest Products, Inc.
Santa Fe Tank Div., Fluor Products Co.

### 594 Tanks & Vessels, Pressure (Including Autoclaves, etc.)

ACF Industries, Inc., American Car & Foundry Div.
Alco Products, Inc.
Ampco Metal, Inc.
**BETHLEHEM STEEL CO.**

Chicago Bridge & Iron Co.
Colorado Fuel & Iron Corp.
Combustion Engineering, Inc.
Eastern Steel Plate Fabricators, Inc.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Keeler, E., Co.
Pacific Coast Engineering Co.
Southwestern Engineering Co.
Vulcan-Cincinnati, Inc.
Westinghouse Air Brake Co., Ind. Products Div.

### 595 Tarpaulins & Tenting

Daniels C. R., Inc.

### (Telephones—see Communications)

### (Television—see Communications)

### (Thermometers & Thermocouples—see Meter, Temperature)

### 596 Thickeners — *also see* Classifiers; Filters; Separators; Screens

Dagley Mfg. Co.
Denver Equipment Co.
**DIESEL ENERGY CORP.**
**EIMCO CORP.**
**GENERAL AMERICAN TRANSPORTATION CORP.**
Graver Water Conditioning Co., Union Tank Car Co. Div.
**HARDINGE CO., INC.**
Infilco, Inc.
Kloeckner-Humboldt-Deutz AG
**LINK-BELT CO.**
**MORSE BROS. MACHINERY CO.**
Roberts & Schaefer Co., Div. Thompson-Starrett Co., Inc.
Santa Fe Tank Div., Fluor Products Co.
Stein, Hall & Co., Inc.

### (Timber Connectors, Special —does not include Fasteners)

### 597 Timber-Framing Machines

Denver Equipment Co.
**STEARNS ROGER MFG. CO.**

### 598 Timber Preservatives

Carbolineum Wood Preserving Co.
Koppers Co., Inc.
Osmose Wood Preserving Co.
Reilly Tar & Chemical Corp.

### 600 Tires & Tubes

**FIRESTONE TIRE & RUBBER CO.**
**GATES RUBBER CO.**
**GENERAL TIRE & RUBBER CO.**
**GOODRICH, B. F., CO., TRUCK & BUS TIRE DEPT.**
**GOODYEAR TIRE & RUBBER CO.**
Kelly-Springfield Tire Co.
**SEIBERLING RUBBER CO.**
**U. S. RUBBER CO.**
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**

### 601 Tools, Hand & Hand-Held Power Tools—does not include Car Derailers & Rerailers; Car Movers, hand; Hoists, Lift, Hand chain; Jacks; Rail Benders; Track Gage-Rods & Levels; Shop Equipment, Powered (Lathes, etc.); Lubricating Equipment; Car Wheel & Gear Pullers; Concrete Placers; Kiln & Industrial Guns; Stud Drivers; Rail Drills & Punches; Timbering Machines; Geologist's Equip.; Welding & Cutting Equip.; Burners; Instruments; Meters and Gages

Ampco Metal, Inc.
Black & Decker Mfg. Co.
**CHICAGO PNEUMATIC TOOL CO.**
Greene, Tweed & Co.
Guyan Machinery Co.
Hauck Mfg. Co., Equipment Div.
Ideal Industries, Inc.
**INGERSOLL-RAND CO.**
Interstate Drop Forge Co., Special Products Division
Lombard Governor Corp.
Lufkin Rule Co.
McCulloch Corp., Chain Saw Div.
Owatonna Tool Co.
Proto Tool Div., Pendleton Tool Industries
Porter-Cable Machine Co.
Remington Arms Co., Inc.
Ridge Tool Co.
Snap-on-Tools Corp.
**THOR POWER TOOL CO.**
**VICTAULIC CO. OF AMERICA**
Western Gear Corp., Industrial Pdts. Div.
**WHEEL TRUEING TOOL CO.**
Wright Power Saw & Tool Corp., Thomas Industries

### (Tools, Power—see above or Shop Equipment)

### (Towers, Extensible & Moble —see Booms)

### (Track—see below; *also see* Rail)

### 602 Track-Cleaning Machines

**AMERICAN MINE DOOR CO.**
Athey Products Corp.
**NORDBERG MFG. CO.**
Pettibone Mulliken Corp.

### 603 Track Gage-Rods & Levels

**BETHLEHEM STEEL CO.**
Foster, L. B., Co.
Frank, M. K.
West Virginia Works, Connors Steel Div., H. K. Porter Co., Inc.

### 604 Track Shifter, Laying & Other Machines

Fletcher, J. H., & Co.
**NORDBERG MFG. CO.**
Pettibone Mulliken Corp.

### 605 Tractors, Crawler

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Case, J. I., Co.
**CATERPILLAR TRACTOR CO.**
**DEERE & CO.**
**EIMCO CORP.**
**EUCLID DIV., GENERAL MOTORS CORP.**
Hough, Frank G., Co.
**LeTOURNEAU-WESTINGHOUSE CO.**
Midwestern Engine & Equipment Co.
Oliver Corp.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV.**

### 606 Tractors, Wheeled—does not include Track Tractors; *also see* Car Movers

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**Case, J. I., Industrial Div.**
**CATERPILLAR TRACTOR CO.**
**DEERE & CO.**
FWD Corp.
Federal Motor Truck Div., Napco Industries, Inc.
Hough, Frank G., Co.
Kloeckner-Humboldt-Deutz AG
**LeTOURNEAU, INC.**
**LeTOURNEAU-WESTINGHOUSE CO.**
Midwestern Engine & Equipment Co.
Oliver Corp.
Porter-Cable Machine Co.
Westfall Equipment Co.

### 607 Tractor Attachments — *also see* Loaders

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Case, J. I., Co.
**CATERPILLAR TRACTOR CO.**
**DEERE & CO.**
**EIMCO CORP.**
Federal Motor Truck Div., Napco Industries, Inc.
Gar Wood Industries, Inc.
Greenville Steel Car Co.
Hough, Frank G., Co.
Hyster Co.
Kloeckner-Humboldt-Deutz AG
Koehring Co.
**LeTOURNEAU-WESTINGHOUSE CO.**
Manganese Steel Forge Co.
Midwestern Engine & Equipment Co.
Oliver Corp.
Porter-Cable Machine Co.
Preco, Inc.

### 608 Tractor & Earthmoving Equipment Wear — Replacement Parts

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
**CATERPILLAR TRACTOR CO.**
Colorado Fuel & Iron Corp.
**EUCLID DIV., GENERAL MOTORS CORP.**
**EIMCO CORP.**
FWD Corp.
Gar Wood Industries, Inc.
Interstate Equipment Corp.
Kloeckner-Humboldt-Deutz AG
**LeTOURNEAU-WESTINGHOUSE CO.**
Midwestern Engine & Equipment Co.
Oliver Corp.
Taylor Wharton Div., Harsco Corp.

### 609 Trailers & Wagons For Motortruck & Tractor—*also see* Scrapers; Trucks & Trailers, Special Self-Loading

**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV.**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Anthony Co.
Athey Products Corp.
**CATERPILLAR TRACTOR CO.**
**DIFFERENTIAL STEEL CAR CO.**
Gar Wood Industries, Inc.
**HILLIBURTON OIL WELL CEMENTING**
Heil Co.—TEC Division
Hyster Co.

### 610 Tramp Iron Detectors

**ASEA ELECTRIC, INC.**

### 611 Transits, Pocket

**AINSWORTH, WILLIAM & SONS**
Geo Optic & Paper Corp.
Geophysical Insturment & Supply
Frederick Post Co.
Warren-Knight Co.

### (Transmissions—see Drives)

### (Traps—see Pipeline Traps)

### (Trolley (Electrical Haulage) Accessories — see Electric Trolley Accessories)

### 612 Truck, Tractor & Trailer Accessories — *also see* Engine Accessories; Electric

Caster Mold & Machine Co.
Chrysler Corp., Dodge Truck Div.
Heil Co.—TEC Division
**INTERNATIONAL HARVESTER CO., MOTOR TRUCK DIV.**

### 613 Truck & Trailer Bodies

Anthony Co.
Athey Products Corp.
**DIFFERENTIAL STEEL CAR CO.**
Galion Allsteel Body Co.
Gar Wood Industries, Inc.
**HILLIBURTON OIL WELL CEMENTING**
Heil Co.—TEC Division
Hercules Steel Products Co.
**INTERNATIONAL HARVESTER CO., MOTOR TRUCK DIV.**
**KW-DART TRUCK CO.**
Southwestern Industrial Electronics Co.

**(Truck & Trailer Dumping Devices—see Car & Truck Dumping Devices)**

**(Truck Trailers—see Trailers)**

### 614 Trucks (Motor) & Truck Tractors—*also see below and Scrapers; Trailers*

**AUTOCAR DIV., WHITE MOTOR CO.**
**CATERPILLAR TRACTOR CO.**
Chrysler Corp., Dodge Truck Div.
F. A. B. Mfg. Co.
FWD Corp.
Ford Motor Co.
**INTERNATIONAL HARVESTER CO., MOTOR TRUCK DIV.**
**KW-DART TRUCK CO.**
Kenworth Mortor Truck Co., Div., Pacific Car & Foundry Co.
Koehring Co.
**LeTOURNEAU-WESTINGHOUSE CO.**
**MACK TRUCKS, INC.**
Midwestern Engine & Equipment Co.
Oshkosh Motor Truck, Inc.
Reo Div., White Motor Co.
Walter Motor Truck Co.

### 615 Trucks, Lift, Fork & Platform

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
Baker Industrial Trucs Div., Otis Elevator Co.
Case, J. I., Co., Industrial Div.
Hyster Co.
Koehring Co.
Oliver Corp.
Pettibone Mulliken Corp.
Prime Mover Co.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 616 Trucks, Dump—does not include Trucks, Shuttle Car, Shuttle Buggy or Special Self Loading

Anthony Co.
Athey Products Corp.
**AUTOCAR DIV., WHITE MOTOR CO.**
Chrysler Corp., Dodge Truck Div.
**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV.**
**DIFFERENTIAL STEEL CAR CO.**
**EUCLID DIV., GENERAL MOTORS CORP.**
FWD Corp.
Ford Motor Co.
Getman Brothers
Heil Co.—TEC Division
**INTERNATIONAL HARVESTER CO., MOTOR TRUCK DIV.**
**KW-DART TRUCK CO.**
Koehring Co.
**LeTOURNEAU, INC.**
**LeTOURNEAU-WESTINGHOUSE CO.**
**MACK TRUCKS, INC.**
Oshkosh Motor Truck, Inc.
Walter Motor Truck Co.

### 617 Trucks, Shuttle Buggy (—½ cu yd)

Getman Brothers
Prime Mover Co.

### 618 Trucks, Shuttle Car (+½ cu yd)—*also see above*

Case, J. I., Co.
Getman Brothers
Goodman Mfg. Co.
**JOY MFG. CO.**
**KW-DART TRUCK CO.**
Myers-Whaley Co., Inc.
National Mine Service Co.
Prime Mover Co.

### 619 Trucks & Trailers, Special Self-Loading—does not include Scrapers or units with load moving devices alone, such as Trucks, Shuttle Cars

Heil Co.—TEC Division
**MACHINERY CENTER, INC.**

**(Turbines—see Engines)**

# U

### 620 Ultraviolet Light

Fisher Research Laboratory, Inc.
Geophysicla Instrument & Supply
Magnaflux Corp.
Scott Williams Minera Co., Inc.
Stratex Instrument Co.
Ultra-Violet Products, Inc.
**WESTINGHOUSE ELECTRIC CORP.**

### 621 Unloaders, R.R., Car & Truck

**GENERAL AMERICAN TRANSPORTATION CORP.**
**LINK-BELT CO.**
Lippmann Engineering Works, Inc.
Midwestern Engine & Equipment Co.
Pettibone Mulliken Corp.
Stephens-Adamson Mfg. Co.

**(Used Equipment — see Searchlight Section, p000)**

# V

### 622 Valve Operating Mechanisms—does not include Controls

**BAILEY METER CO.**
Conrader Co., Inc.
Crane Co., Industrial Products Group
Darling Valve & Mfg. Co.
Farris Corp.
Foster, L. B., Co.
Golden-Anderson Valve Specialty
Grinnell Co., Inc.
Infilco, Inc.
Megator Corp.
OPW-Jordan Corp.
Ohio Injector Co.
Philadelphia Gear Corp.
Rockwell Mfg. Co.

### 623 Valves

Alco Products, Inc.
**ALLEN-SHERMAN-HOFF PUMP CO.**
American Chain & Cable Co., R-P&C Valve Div.
Automatic Switch Co.
B-I-F Industries, Inc.
**BAILEY METER CO.**
Barksdale Valves
Barrett Haentjens & Co.
Benton Harbor Engineering Works, Inc.
Bitco, Inc.
Cash, A. W., Co.
Cessna Aircraft Co.
Chase Brass & Copper Co.
Clarkson Co.
Cochrane Corp.
Commercial Shearing & Stamping Co.
Conrader Co., Inc.
Crosby Valve & Gage Co.
Darling Valve & Mfg. Co.
DeZurik Corp.
Dill Mfg. Co.
Dixon Valve & Coupling Co.
Duriron Co., Inc.
Eastman-Pacific Co.
Edward Valves, Inc.
Fairmont Machinery Co.
Farris Corp.
Farris Flexible Valve Corp.
Flood City Brass & Elec. Co.
Foster, L. B., Co.
Galigher Co.
Galland Henning Mfg. Co., Nopak Div.
Golden-Anderson Valve Specialty
Graver Water Conditioning Co., Union Tank Car Co., Div.
Grinnell Co., Inc.
Guyan Machinery Co.
Hauck Mfg. Co., Equipment Div.
Hose Accessories Co.
**JENKINS BROS.**
Kennedy Valve Mfg. Co.
Keystone Valve Corp.
Knox Mfg. Co.
Ladish Co.
Ledeen Mfg. Co.
**LINATEX CORP. OF AMERICA**
Lunkenheimer Co.
**McNALLY PITTSBURG MFG. CORP.**
Meehanite Corp.
Megator Corp.
Metal Goods Corp.
**MINE & SMELTER SUPPLY CO.**
Minneapolis-Honeywell Regulator
**MISSION MFG. CO.**
Mueller Co.
OPW-Jordan corp.
**OHIO BRASS CO.**
Oilgear Co.
Olds Alloy Co.
Owatonna Tool Co.
Parker-Hannifin Corp.
Powel, William, Co.
Red Jacket Co., Inc.
Rockiron Co., Ltd.
Rockwell Mfg. Co.
Rockwell, W. S., Co.
Stockham Valves & Fittings
U. S. Hoffman Machinery Corp., Air Appliance Div.
**U. S. RUBBER CO., MECHANICAL GOODS DIV.**
Vickers, Inc.
**VICTAULIC CO. OF AMERICA**
Vogt, Henry, Machine Co.
Walworth Co.
Westinghouse Air Brake Co., Ind. Products Div.
Yarnall-Waring Co.

### 624 Ventilation Tubing, Non-Metallic—does not include Pipe, Ventilation

**AMERICAN BRATTICE CLOTH CORP.**
**BEMIS BROS. BAG CO.**
**FLEXAUST CO.**
Flexible Tubing Co.
Rockiron Co., Ltd.

### 625 Vibrators & Vibrating Mechanisms—*also see Core Shakers; Screen Eccentrics*

**CHICAGO PNEUMATIC TOOL CO.**
Cleveland Vibrator Co.
Derrick Mfg. Co.
**DIESEL ENERGY CORP.**
**DRAVO CORP.**
**ERIEZ MFG. CO.**
Fairmont Machinery Co.
**HEWITT-ROBBINS, INC.**
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Martin Engineering Co.
Midwestern Engine & Equipment Co.
Multi-Metal Wire Cloth Co., Inc.
Overstrom & Sons, Inc.
Remington Arms Co., Inc.
Stephens-Adamson Mfg. Co.
**TYLER, W. S., CO.**
Viber Co.
**WESTERN GEAR CORP., INDUSTRIAL PDTS DIV.**

# W

**(Wagon Drills—see Drills)**

**(Washers, Mineral Log, Pug, etc.—see *Scrubbers*)**

### 626 Washing Plants, Sand & Gravel, Complete, Mobile & Portable

**BALDWIN-LIMA-HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV.**
Bodinson Mfg. Co., Inc.
Davis Foundry & Machine Works
Denver Equipment Co.
Diamond Iron Works Div., Goodman Mfg. Co.
**DORR OLIVER, INC.**
Eagle Iron Works
Hack Engineering Co.
Industrial Engineering & Construction Co.
**IOWA MFG. CO.**
Lippmann Engineering Works, Inc.
**McLANAHAN & STONE CORP.**
Pioneer Engineering Div.
Smith Engineering Works
Universal Dredge Mfg. Co.
Universal Engineering Corp.
Universal Road Machinery Co.
**WESTERN MACHINERY CO., WEMCO DIV.**

### 627 Water Clarification & Treatment Equipment—*also see* Ion Exchange

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
B-I-F Industries, Inc.
Chain Belt Co.
Cochrane Corp.
Denver Equipment Co.
**DORR OLIVER, INC.**
**DRAVO CORP.**
**EIMCO CORP.**
Graver Water Conditioning Co., Union Tank Car Co. Div.
Industrial Engineering & Construction Co.
Infilco, Inc.

Ionics, Inc.
Jeffrey Mfg. Co.
**LINK-BELT CO.**
Multi-Metal Wire Cloth Co., Inc.
Permutit Co., Div Pfaudler Permutit, Inc.
Sharples Corp.
Wallace & Tiernan, Inc.

### 628 Water Clarification & Treatment Chemicals—does not include Ion Exchange Resins—*also see* Flocculating Reagents

**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP**
**ARMOUR INDUSTRIAL CHEMICAL CO.**
**BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP.**
Dow Chemical Co.
Fisher Scientific Co.
Food Machinery & Chemical Corp., Mineral Products Div., Chlor-Alkali Div.
General Chemical Div., Allied Chemical Corp.
Hagan Chemicals & Controls, Inc., Calgon Co., Hall Laboratories
**HARDINGE CO., INC.**
Marathon Div., American Can Co.
Nalco Chemical Co.
Onyx Chemical Corp.
Pacific Lumber Co.
Pennsalt Chemicals Corp.
Permutit Co., Div., Pfaudler Permutit, Inc.
**PHILADELPHIA QUARTZ CO.**
Stein, Hall & Co., Inc.
Tennessee Corp.

### (Weigh Hoppers—*see* Scales)

### 629 Welding & Cutting Equipment — *also see* Metallizing Equipment

**ALLOY RODS CO.**
Arcair Co.
Arcos Corp.
Flood City Brass & Elec. Co.
**HARNISCHFEGER CORP.**
Hobart Bros. Co.
Industrial Air Products Co.
Lincoln Electric Co.
Linde Co., Union Carbide Corp.
Marquette Mfg. Co., Inc.
Miller Electric Mfg. Co.
Rexarc, Inc., Sight Feed Generator Co.
Rome Cable Corp., Rome Cable Division of Alcoa
Ryerson & Son, Inc.
Smith Welding Equipment Corp.
Tweco Products, Inc.
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**
**WESTINGHOUSE ELECTRIC CORP.**

### 630 Welding Rods, Electrodes, Solder, etc.—*see* Metallizing Equipment

**ALLOY RODS CO.**
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
American Chain & Cable Co., Page Steel & Wire Div.
Ampco Metal, Inc.
Arcair Co.
Arcos Corp.
Belmont Smelting & Refining Works
Eutectic Welding Alloys Corp.
Flood City Brass & Elec. Co.
**HARNISCHFEGER CORP.**
Haynes Stellite Co., Div., Union Carbide Corp.
Helwig Co.
Hobart Bros. Co.
Industrial Air Products Co.
**INTERNATIONAL NICKEL CO.**
Lincoln Electric Co.
Lukens Steel Co.
Marquette Mfg. Co., Inc.
McKay Co.
Metal Goods Corp.
National Carbon Co., Union Carbide Corp.
Ohio Carbon Co.
Rexarc, Inc., Sight Feed Generator Co.
Stackpole Carbon Co.
Sylvania Electric Products, Inc., Chemical & Metallurgical Div.
Taylor Wharton Div., Harsco Corp.
**WESTINGHOUSE ELECTRIC CORP.**
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV.**

### 631 Weldments — *also see* Bucket Teeth; Castings; Forging; Tractor Wear-Replacement Parts

Alco Products, Inc.
American Brake Shoe Co.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV.**
Ampco Metal, Inc.
**BETHLEHEM STEEL CO.**
Eastern Steel Plate Fabricators, Inc.
Enterprise Wheel & Car Corp.
**GENERAL AMERICAN TRANSPORTATION CORP.**
Industrial Air Products Co.
Ladish Co.
Lukens Steel Co.
Marquette Mfg. Co., Inc.
**NORDBERG MFG. CO.**
Ryerson & Son, Inc.
Sorel Steel Foundries, Ltd.
Standard Metal Mfg. Co.
**TREADWELL, M. H., CO., INC.**
Wheeler, C. H., Mfg. Co.

### 632 Winches, Air

**ATLAS COPCO**
**CHICAGO PNEUMATIC TOOL CO.**
Crane Co., Industrial Products Group
**EIMCO CORP.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Lidgerwood Mfg. Co.
**MACHINERY CENTER, INC.**
Round & Son, Inc.
Shepard Niles Crane & Hoist Corp.
**THOR POWER TOOL CO.**

### 633 Winches, Diesel & Gasoline

Gar Wood Industries, Inc.
Hyster Co.
**JOY MFG. CO.**
Lidgerwood Mfg. Co.
Superior-Lidgerwood-Mundy Corp.

### 634 Winches, Electric

**CHICAGO PNEUMATIC TOOL CO.**
Gar Wood Industries, Inc.
**HARNISCHFEGER CORP.**
**JOY MFG. CO.**
Kersey Mfg. Co., Inc.
Lakeside Bridge & Steel Co.
**LeTOURNEAU, INC.**
Lidgerwood Mfg. Co.
**LINK-BELT CO.**
Robbins & Myers, Inc.
Round & Son, Inc.
**SAUERMAN BROS., INC.**
Shepard Niles Crane & Hoist Corp.
Stephens-Adamson Mfg. Co.
Superior-Lidgerwood-Mundy Corp.
**VULCAN IRON WORKS CO.**

### 635 Winches, Hand — does not include Hoists, Lift, Hand Chain

Harrington Co.
**LINK-BELT CO.**
Round & Son, Inc.
Stephens-Adamson Mfg. Co.

### 636 Winches, Hydraulic

Lakeside Bridge & Steel Co.
Lidgerwood Mfg. Co.
Midwestern Engine & Equipment Co.
Vickers, Inc.

### 637 Winches, Portable & Movable

**CHICAGO PNEUMATIC TOOL CO.**
**INGERSOLL-RAND CO.**
**JOY MFG. CO.**
Lidgerwood Mfg. Co.
**LINK-BELT CO.**
Midwestern Engine & Equipment Co.
Round & Son, Inc.
Shepard Niles Crane & Hoist Corp.

### 638 Winches, Stationary

Christian, J. D., Engineers
**JOY MFG. CO.**
Lidgerwood Mfg. Co.
**LINK-BELT CO.**
Round & Son, Inc.
**SAUERMAN BROS., INC.**
Shepard Niles Crane & Hoist Corp.
Superior-Lidgerwood-Mundy Corp.
Vickers, Inc., Tulsa Products Div.
Yale & Towne Mfg. Co., Yale Materials Handling Div.

### 639 Wire Cloth

**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
Buffalo Wire Works Co.
Cambridge Wire Cloth Co.
Chase Brass & Copper Co.
Colorado Fuel & Iron Corp.
Flocker, John, & Co.
**HEWITT-ROBINS, INC.**
Hoyt Wire Cloth Co.
**IOWA MFG. CO.**
Manganese Steel Forge Co.
Metal Goods Corp.
Multi-Metal Wire Cloth Co., Inc.
National Standard Co.
Newark Wire Cloth Co.
Simplicity Engineering Co.
Southwestern Engineering Co.
Star Wire Screen & Iron Works, Inc.
**TYLER, W. S., CO.**
**U. S. STEEL CORP.**

### (Wire Fencing—*see* Fencing)

### 640 Wire Rope

American Chain & Cable Co., American Cable Div.
American Chain & Cable Co., Hazard Wire Rope Div.
**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
Bergen Wire Rope
**BETHLEHEM STEEL CO.**
Bitco, Inc.
**BRODERICK & BASCOM ROPE CO.**
Chase Brass & Copper Co.
Colorado Fuel & Iron Corp.
Flocker, John, & Co.
Hulburt Oil & Grease Co.
Jones & Laughlin Steel Corp.
**LESCHEN WIRE ROPE DIV., H. K. PORTER CO., INC.**
**LeTOURNEAU-WESTINGHOUSE CO.**
Macwhyte Wire Rope Co.
Metal Goods Corp.
Midwestern Engine & Equipment Co.
**RIBLET TRAMWAY CO.**
**ROEBLING'S, JOHN A., SONS, DIV., COLORADO FUEL & IRON CORP.**
Ryerson & Son, Inc.
**SAUERMAN BROS., INC.**
Union Wire Rope Corp., Armco Steel Corp.
**U. S. STEEL CORP.**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
Wire Rope Corp. of America, Inc.

### (Wire Rope Dressing — *see* Lubricants)

### 641 Wire Rope Fittings

American Chain & Cable Co., American Cable Div.
American Chain & Cable Co., Hazard Wire Rope Div.
**AMERICAN HOIST & DERRICK CO.**
**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
Bergen Wire Rope
**BETHLEHEM STEEL CO.**
**BRODERICK & BASCOM ROPE CO.**
Colorado Fuel & Iron Corp.
**ELECTRIC STEEL FOUNDRY CO.**
Flocker, John, & Co.
Interstate Drop Forge Co., Special Products Division
Jones & Laughlin Steel Corp.
Lamson & Sessions Co.
**LESCHEN WIRE ROPE DIV., H. K. PORTER CO., INC.**
Macwhyte Wire Rope Co.
Midwestern Engine & Equipment Co.
Ryerson & Son, Inc.
**SAUERMAN BROS., INC.**
Sorel Steel Foundries, Ltd.
Union Wire Rope Corp., Armco Steel Corp.
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV.**
Wire Rope Corp. of America, Inc.

### 642 Wire Rope Slings

American Chain & Cable Co., American Cable Div.
American Chain & Cable Co., Hazard Wire Rope Div.
**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP.**
Bergen Wire Rope
**BETHLEHEM STEEL CO.**
**BRODERICK & BASCOM ROPE CO.**
Colorado Fuel & Iron Corp.
Flocker, John, & Co.
Jones & Laughlin Steel Corp.
**LESCHEN WIRE ROPE DIV., H. K. PORTER CO., INC.**
Macwhyte Wire Rope Co.
Midwestern Engine & Equipment Co.
**ROEBLING'S, JOHN A., SONS, DIV., COLORADO FUEL & IRON CORP.**
Ryerson & Son, Inc.
Union Wire Rope Corp., Armco Steel Corp.
**U. S. STEEL CORP., COLUBMIA-GENEVA STEEL DIV.**
Wire Rope Corp. of America, Inc.

# PART 2

# Manufacturer's Index

**Use this section:**

**1) To locate the mailing address of the manufacturer, who will supply more information at your request.**

**2) To find the advertisement in this issue by the manufacturers whose names are in bold face.**
**The page number follows the address listing.**

# E&MJ's

# 1960 Manufacturer's Index

***— revised and up-dated to give you a more pertinent directory.***

## A

ACF Industries, Inc., American Car & Foundry Div., 750 Third Ave., New York 17, N. Y.
AGA Corp. of America, 2013 Park Ave., South Plainfield, N. J.
Abbe Engineering Co., 622C Graybar Bldg., New York 17, N. Y.
Abrams Aerial Survey Corp., 606 Shiawassee St., Lansing, Mich.
**ACKER DRILL CO., INC., Box 830, Scranton, Pa. pp.364,400**
**ACME HAMILTON MFG. CORP., Meade St., Trenton 3, N. J. p7**
Acrow Corp. of America, 231 Washington Ave., Carlstadt, N. J.
Adamas Carbide Corp., 121 Market St., Kenelworth, N. J.
**AERO SERVICE CORP., 210 E. Courtland St., Philadelphia 20, Pa. p160**
Aero Service Corp. (Mid-Continent), 1401 S. Detroit St., Tulsa, Okla.
Aero Service Corp. (Western), 35 Richards St., Salt Lake City 1, Utah
Aeroquip Corp., 300 South East Ave., Jackson, Mich.
Aeroquip Corp., Western Div., 3015 Winona Ave., Burbank, Calif.
Aerotec Industries, Inc., 2 Meadow St., South Norwalk, Conn.
**AINSWORTH, WILLIAM, & SONS, 2151 Lawrence St., Denver 5, Colo. p402**
Air Placement Equipment Co., 1000 W. 25 St., Kansas City 8, Mo.
Ajax Flexible Coupling Co., Westfield, N. Y.
Akron Metallic Gasket Co., 150 N. Union St., Akron 9, Ohio
Albany Felt Co., 1373 Broadway, Albany 1, N. Y.
Alco Products Inc., Dept. 915, Schenectady 5, N. Y.
**ALIMAK CORP., 301 Avila St., San Francisco 23, Calif. p348**
Allegheny Ludlum Steel Corp., Oliver Bldg., Pittsburgh 22, Pa.
Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee 4, Wis.
**ALLEN-SHERMAN-HOFF PUMP CO., Box 635, Paoli, Pa., Second Cover**
Allied Chemical Corp., Solvay Process Div., 61 Broadway, New York 6, N. Y.
**ALLIS CHALMERS MFG. CO., CONSTRUCTION MACHINERY DIV., 1126 S. 70 St., Milwaukee, Wis. pp71, 72, 73, 74, 86, 87**
**ALLIS-CHALMERS MFG. CO., ENGINEMATERIAL HANDLING DIV., 1133 S. 70 St., Milwaukee 14, Wis. pp71, 72, 73, 74, 86, 87**
**ALLIS-CHALMERS MFG. CO., INDUSTRIES GROUP, 969 S. 70th St., Milwaukee 1, Wis. pp71, 72, 73, 74, 86, 87**
Allis, Louis, Co., 427 E. Stewart St., Milwaukee 1, Wis.
**ALLOY RODS CO., Box 1828, York, Pa. p14**
Alpha Molykote Corp., 65 Harvard St., Stamford, Conn.
Aluminum Co. of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa.
Amercoat Corp., 4809 Firestone Blvd., South Gate, Calif.
**AMERICAN AIR FILTER CO.,INC., 215 Central Ave., Louisville 8, Ky. pp332-333**
American Air Surveys, Inc., 907 Penn Ave., Pittsburgh 22, Pa.
**AMERICAN BILTRITE RUBBER CO., BOSTON WOVEN HOSE & RUBBER DIV., Boston 3, Mass. p176**
American Brake Shoe Co., 530 Fifth Ave., New York 17, N. Y.
**AMERICAN BRAKE SHOE CO., AMERICAN MANGANESE STEEL DIV., 389 E. 14 St., Chicago Heights, Ill. pp370-371**
**AMERICAN BRATTICE CLOTH CORP., Warsaw, Ind. p390**
American Bridge Div., U. S. Steel Corp., 204 Frick Bldg., Pittsburgh 30, Pa.
American Cast Iron Pipe Co., Birmingham, Ala.
American Chain & Cable Co., American Cable Div., Wilkes-Barre, Pa.
American Chain & Cable Co., Automotive & Aircraft Div., 601 Stephenson Bldg., Detroit 2, Mich.
American Chain & Cable Co., Hazard Wire Rope Div., Wilkes-Barre, Pa.
American Chain & Cable Co., Page Steel & Wire Div., Monessen, Pa.
American Chain & Cable Co., R-P&C Valve Div., Reading Pa.
American Chain & Cable Co., Wright Hoist Div., 735 Hay St., York, Pa.
American Chain Div., American Chain & Cable Co., Inc., York, Pa.
American Coldset Corp., U. S. Highway 46, Teterboro, N. J.
American Crucible Products Co., 1305 Oberlin Ave., Lorain, Ohio
**AMERICAN CYANAMID CO., EXPLOSIVES & MINING CHEMICALS DEPT., 30 Rockefeller Plaza, New York 20, N. Y. p63**
American Hard Rubber Co., Div., Amerace Corp., 200 E. 42 St., New York 17, N. Y.
**AMERICAN HOIST & DERRICK CO., 63 S. Robert St., St. Paul 7, Minn. p404**
**AMERICAN MACHINE & METALS, INC., DE BOTHEZAT FANS DIV., East Moline, Ill. p164**
**AMERICAN MINE DOOR CO., 2039 Dueber Ave., S. W., Canton 6, Ohio p179**
American Optical Co., Safety Products Div., 98 Mechanic St., Southbridge, Mass.
American Paulin System, 1524 S. Flower St., Los Angeles 15, Calif.
**AMERICAN POTASH & CHEMICAL CO., 3000 W. 6 St., Los Angeles 45, Calif. p79**
American Pulley Co., 4200 Wissahicken Ave., Philadelphia 29, Pa.
American Pulverizer Co., 1275 Macklin Ave., St. Louis 10, Mo.
American Rubber Mfg. Co., 1145 Park Ave., Oakland 8, Calif.
**AMERICAN SMELTING & REFINING CO., FEDERATED METALS DIV., 120 Broadway, New York 5, N. Y. p357**
American Standard Industrial Div., Detroit 32, Mich.
**AMERICAN STEEL FOUNDRIES, Prudential Plaza, Chicago 1, Ill. p177**
**AMERICAN STEEL & WIRE DIV., U. S. STEEL CORP., Rockefeller Bldg., Cleveland, Ohio pp58-59, 138-139**
Ames Iron Works, Inc., 25 E. 2 St., Oswego, N. Y.
Ammann, Jack, Inc., Engineers & Surveyors, 931 Broadway, San Antonio, Texas
Ampco Metal, Inc., 1739 S. 38 St., Milwaukee 1, Wis.
**ANACONDA WIRE & CABLE CO., 25 Broadway, New York 4, N. Y. pp158-159**
Analytical Measurements, Inc., 585 Main St., Chatham, N. J.
Anchor Coupling Co., 342 N. Fourth St., Libertyville, Ill.
Ansul Chemical Co., Marinette, Wis.
Anthony Co., Streator, Ill.
Apache Powder Co., Benson, Ariz.
Arcair Co., Box 431, Dept. E-MJ, Lancaster, Ohio
Arcos Corp., 1500 S. 50 St., Philadelphia 43, Pa.

Arizona Chemical Co., 30 Rockefeller Plaza, New York 20, N. Y.
Arizona Testing Laboratories, 817 W. Madison St., Phoenix, Ariz.
Armco Drainage & Metal Products, 703 Curtis St., Middletown, Ohio
Armco Steel Corp., 703 Curtis St., Middletown, Ohio
Armour Industrial Chemical Co., 110 N. Wacker Dr., Chicago 6, Ill., pp147, 148
Armstrong, Bray & Co., 5364 Northwest Hwy., Chicago 30, Ill.
Arrow Tank Co., 16 Barnett St., Buffalo 15, N. Y.
Arrowhead Steel Buildings, Inc., 1122 W. Railroad St., Duluth 2, Minn.
**ASEA ELECTRIC, INC., 500 Fifth Ave., New York 36, N. Y. p345**
Associated Metals & Minerals Corp., 75 West St., New York 6, N. Y.
Athey Products Corp., 5631 W. 65 St., Chicago 38, Ill.
Atlantic Refining Co, 260 S. Broad St., Philadelphia, Pa.
**ATLAS CAR & MFG. CO., 100 Ivanhoe Rd., Cleveland 10, Ohio p388**
Atlas Chain & Mfg. Co., Box 708, West Pittston, Pa.
**ATLAS COPCO, 545 Fifth Ave., New York 17, N. Y. pp309, 310-311**
**ATLAS POWDER CO., Wilmington 99, Del. pp66-67**
Atlas Steel Casting Co., 1963 Elmwood Ave., Buffalo 7, N. Y.
Atlas Steels, Ltd., Welland, Ontario, Canada
Austin-Western, Construction Equipment Div., Baldwin-Lima-Hamilton Corp., Aurora, Ill.
**AUTOCAR DIV., WHITE MOTOR CO., Lancaster Pike, Exton, Pa. p399**
Automatic Switch Co., Hanover Rd., Florham Park, N. J.
Automatic Vulcanizers Co.,16 Hudson St., New York 1, N.Y.

# B

B-I-F Industries, Inc., 345 Harris Ave., Providence 1, R. I.
**BABCOCK & WILCOX CO., 161 E. 42nd St., New York 17, N. Y. pp16, 376-377**
**BAILEY METER CO., 1050 Ivanhoe Rd., Cleveland, Ohio p162**
**BAKER & ADAMSON PRODUCTS, GENERAL CHEMICAL DIV., ALLIED CHEMICAL CORP., 40 Rector St., New York 6, N. Y. p405**
Baker Chemical Co., Phillipsburg, N. J.
Baker Industrial Trucks Div., Otis Elevator Co., 8000 Baker Ave., N. W. Cleveland 2, Ohio
**BALDWIN- LIMA- HAMILTON CORP., CONSTRUCTION EQUIPMENT DIV., South Main St., Lima, Ohio p379**
**BALDWIN- LIMA- HAMILTON CORP., INDUSTRIAL EQUIPMENT DIV., Philadelphia 42, Pa. p347**
**BALDWIN- LIMA- HAMILTON CORP., STANDARD STEEL WORKS DIV., Burnham, Pa.**
**BARBER-GREENE CO., 400 N. Highland Ave., Aurora, Ill. pp132-133**
Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Calif.
Barnes Mfg. Co., 651 N. Main St., Mansfield, Ohio
Barrett Haentjens & Co., Hazleton, Pa.
Bausch & Lomb Optical Co., Scientific Products Div., 83760 Bausch St., Rochester 2, N. Y.
Bay State Abrasive Products Co., 12 Union St., Westboro, Mass.
Beach-Russ Co., 420 Lexington Ave., New York, N. Y.
Bechtal Corp., 220 Bush St., San Francisco 4, Calif.
Beckman Instrument, Inc., Scientific & Process Instruments Div., 2500 Fullerton Rd., Fullerton, Calif
Beech Aircraft Corp, 9790 E. Central Wichita, Kan.
Belmont Packing & Rubber Co., Butler & Sepviva Sts., Philadelphia 37, Pa.
Belmont Smelting & Refining Works, 330 Belmont Ave., Brooklyn 7, N. Y.
**BEMIS BROS. BAG CO., 408 Pine St., Box 164, St. Louis 2, Mo. p378**
Benton Harbor Engineering Works, Inc., 622 Langley Ave., St. Joseph, Mich.
Bergen Wire Rope, 141 Gregg St., Lodi, N. J.
Beryllium Corp., Reading, Pa.
Bete Fog Nozzle, Inc. 309 Wells St., Greenfield, Mass.
**BETHLEHEM STEEL CO., Bethlehem, Pa. pp42, 327**
Bico, Inc., 3116 Valhalla Dr., Burbank, Calif.
Bigelow-Liptak Corp., 13300 Puritan Ave., Detroit 27, Mich.
Bin-Dicator Co., 13946-300 Kercheval Ave., Detroit 15, Mich.
Bird Machine Co., South Walpole, Mass.
**BIRDSBORO CORP., Birdsboro, Pa. p146**
Bitco, Inc. Box 255, Cardin, Okla.
Bitco, Inc., E. 4115 Trent Ave., Spokane, Wash.
Bixby-Zimmer Engr. Co., 961 Abingdon St., Galesburg, Ill.
Black & Decker Mfg. Co., 600 E. Pennsylvania Ave., Towson, Md.
Black's Machine Shop, 169 Willow St., Bishop, Calif.
Blaw-Knox Co., Blaw-Knox Bldg., 300 Sixth Ave., Pittsburgh 22, Pa.
Bodinson Mfg. Co., Inc., 2401 Bayshore Blvd., San Francisco, Calif.
Bolton Farm Packing Co., 176 Oak St., Newton 64, Mass.
Bonded Scale & Machine Co., 38 Bellview, Columbus 7, Ohio
Booth Co., Inc., 333 W. 14 S. Salt Lake City 15, Utah
Borden Metal Products Co., Elizabeth, N. J.
Bower Roller Bearing Div., Federal-Mogul-Bower Bearings, Inc., 3040 Hart Ave., Detroit 14, Mich.
Bowers Battery & Spark Plug Co., Box 1262, Reading, Pa.
Boyles Bros. Drilling Co., Ltd. 1275-1291 Parker St., Vancouver 6, Canada
Brady, W. H., Co., 727 Glendale Ave., Milwaukee 9, Wis.
Briggs & Stratton Corp., 2711 N. 13 St., Milwaukee 1, Wis.
Bristol Co., Box 1790 EMJ, Waterbury 20, Conn.
**BRODERICK & BASCOM ROPE CO., 4203 Union Blvd., St. Louis 15, Mo. p85**
Brookville Locomotive Works, Steele Blvd., Brookville, Pa.
**BROWN BOVERI CORP., 19 Rector St., New York 6, N. Y. p156**
Brown, David, Inc., 999 Beecher St., San Leandro, Calif.
Browning Mfg. Co., Maysville, Ky.
**BRUNNER & LAY-EASTERN, INC., 2514-16 E. Cumberland St., Philadelphia 25, Pa. p384**
Bucyrus-Erie Co., South Milwaukee, Wis.
**BUELL ENGINEERING CO., 123 William St., New York, N. Y. pp128-129**
Buffalo Forge Co., 490 Broadway, Buffalo 5, N. Y.
Buffalo Scale Co., Inc. 46 Letchworth St., Buffalo 13, N. Y.
Buffalo Wire Works Co., 449 Terrace Buffalo 2, N. Y.
Bullard, E. D., Co., 2680 Bridgeway Sausalito, Calif.
Burtonite Co., Box 7, Nutley, N. J.
Bury Compressor Co., 1722 Cascade St., Erie, Pa.
Butler Mfg. Co., 7400 E. 13 St., Kansas City 26, Mo.
Byers, A. M., Co., Clark Bldg., Pittsburgh 22, Pa.
Byron Jackson Div., Borg-Warner Corp. Box 2017, Terminal Annex, Los Angeles 54, Calif.

# C

C & D Batteries, Div. Electric Autolite Co., Washington & Cherry Sts., Conshohocken, Pa.
Cadillac Malleable Iron Co., Cadillac, Mich.
Cahn Instrument Corp., 14511 Paramount Blvd., Paramount, Calif.
California Testing Laboratories, 619 E. Washington Blvd., Los Angeles 15, Calif.
Calumet Div., Calumet & Hecla, Inc., Calumet, Mich.
Cambridge Wire Cloth Co., 152 Linkwood Rd., Cambridge, Md.
Campbell, E. K., Co., 1809 Manchester Ave., Kansas City 26, Mo.
Canadian Aero Service Ltd., 348 Queen St., Ottawa, Ontario, Canada
Canadian Industries, Ltd., Box 10, Montreal, Canada
Cannon Concentrator, 1143 Sycamore St., Box 2432, Lakeland, Fla.
Carboline Co., 32 Hanley Ind. Ct., St. Louis 17, Mo.
Carbolineum Wood Preserving Co., 6683 N. 40th St., Milwaukee 9, Wis.
**CARD, C. S., IRON WORKS, 2501 W. 16th Ave., Denver 4, Colo. p338**
Carey, Philip, Mfg. Co., 320 S. Wayne Ave., Cincinnati 15, Ohio
Carlon Products Corp., Box 133, Aurora, Ohio
Carondelet Foundry Co., 2101 S. Kings Highway, St. Louis 10, Mo.
Carpco Mfg., Inc., 4120 Haines St., Jacksonville, Fla.
Carrier Corp., Carrier Parkway, Syracuse 1, N. Y.
Carver Pump Co., Muscatine, Iowa
**CATERPILLAR TRACTOR CO., Peoria, Ill. pp60-61, 119, 330**
Case, J. I., Co., Industrial Div., 700 State St., Racine, Wis.
Cash, A. W., Co., Box 551, Decatur, Ill.
Caster Mold & Machine Co., 1079 E & J St., Barberton, Ohio
Catalytic Construction Co., 1528 Walnut St., Philadelphia 2, Pa.
Cement Gun Co., 1520 Walnut St., Allentown, Pa.
Central Mine Equipment Co., 6200 N. Broadway, St. Louis 15, Mo.
Century Electric Co., 1806 Pine St., St. Louis 3, Mo.
Cessna Aircraft Co., 5800 E. Pawnee Road, Wichita, Kan.
Chain Belt Co., 4679 W. Greenfield Ave., Milwaukee 1, Wis.
Chain Belt Co., Shafer Bearing Div., Belmont Rd. at Curtiss St., Downers Grove, Ill.
Chapman, Wood & Griswold, Ltd., 525 Vernon Dr., Vancouver 6, B. C.
Chase Bag Co., 355 Lexington Ave., New York 17, N. Y.
Chase Brass & Copper Co., 236 Grand St., Waterbury 20, Conn.
**CHEATHAM ELECTRIC SWITCHING DEVICE CO., 4780 Crittenden Dr., Louisville 9, Ky. p431**
Chemical Construction Corp., 525 W. 43 St., New York, N. Y.
Chemical Separations Corp., Box 1031, Oak Ridge, Tenn.
Chester Cable Corp., Oakland Ave., Chester, N. Y.
Chicago Bridge & Iron Co., 332 S. Michigan Ave., Chicago 4, Ill.
Chicago Eye Shield Co., 2727 W Roscoe St., Chicago 18, Ill.
Chicago Perforating Co., 2445 W. 24th Pl., Chicago 8, Ill.
**CHICAGO PNEUMATIC TOOL CO., 6 E. 44th St., New York 17, N. Y. pp145, 386-387**
Chiksan Co., 330 N. Pomona Ave., Brea, Calif.
Chisholm-Moore Hoist Div., Columbus McKinnon Chain Corp., 5045 Fremont Ave., Tonawanda, N. Y.
**CHRISTENSEN DIAMOND PRODUCTS CO., 1937 S. 2 W, Salt Lake City 10, Utah pp80-81**
Christian, J. D., Engineers, 480 Potrero Ave., San Francisco 10, Calif.
Chrysler Corp., Dodge Truck Div., 7900 Joseph Campau Ave., Detroit, Mich.
Cincinnati Rubber Mfg. Co. Div., Thor Power Tool Co., Cincinnati 12, Ohio.
Circle Wire & Cable Corp., 500 Maspeth Ave., Maspeth, N. Y.
Clarage Fan Co., 1 Clarage Place, Kalamazoo, Mich.
**CLARK CONTROLLER CO., 1146 E. 152 St., Cleveland 10, Ohio**
**CLARK EQUIPMENT CO., CONSTRUCTION MACHINERY DIV., Box 599, Pipestone Rd., Benton Harbor, Mich.**
Clarkson Co., 735 Loma Verde Ave., Palo Alto, Calif.
Clayton Mfg. Co., Box 550, El Monte, Calif.
Cleveland Vibrator Co., 2828 Clinton Ave., Cleveland 13, Ohio.
Cleveland Worm & Gear Division, Eaton Mfg. Co., 3300 E. 80th St., Cleveland 4, Ohio.
**CLIMAX MOLYBDENUM CO., 1270 Ave. of the Americas, New York 20, N. Y.**

Clipper Belt Lacer Co., 974 Front St., N. W., Grand Rapids 2, Mich.
Coast Mfg. & Supply Co., Box 71, Livermore, Calif.
**COATES STEEL PRODUCTS CO., Greenville, Ill. p171**
Cochrane Corp., 17th and Allegheny, Philadelphia 32, Pa.
Coeur D'Alenes Co., Wallace, Idaho
Coffing Hoist Div., Duff-Norton Co., 800 Walter St., Danville, Ill.
Collyer Insulated Wire Co., 249 Roosevelt Ave., Pawtucket, R. I.
Colorado Fuel & Iron Corp., Continental Oil Bldg., Denver 2, Colo.
Columbus Conveyor Co., 869 W. Goodale Blvd., Columbus 12, Ohio
Columbus McKinnon Chain Corp., Mining Equipment Div., 56 Fremont Ave., Tonawanda, N. Y.
Combustion Engineering, Inc., 200 Madison Ave., New York 16, N. Y.
Commercial Shearing & Stamping Co., Dept. EMJ-MG, 1775 Logan Ave., Youngstown, Ohio
Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.
**CONNELLSVILLE MFG. & MINE SUPPLY CO., Connellsville, Pa. p352**
Conrader Co., Inc., 236 W. 17 St., Erie, Pa.
Continental Conveyor & Equipment Co., Winfield, Ala.
Continental-Diamond Fibre Corp., Subsidiary Budd Co., Newark, Del.
Continental Rubber Works, 1939 Liberty St., Erie, Pa.
Continental Wire Co., Wallingford, Conn.
Convair, Inc., Box 9671, Pittsburgh 26, Pa.
**COORS PORCELAIN CO., 600 Ninth St., Golden, Colo.**
**COPPUS ENGINEERING CO., 344 Park Ave., Worcester 10, Mass. p368**
Corning Glass Works, Corning, N. Y.
Crane Co. Industrial Products Group, 4100 S. Kedzie Ave., Chicago 32, Ill.
Crescent Belt Fastener Co., 381 Fourth Ave., New York 16, N. Y.
Crosby Valve & Gage Co., 43 Kendrick St., Wrentham, Mass.
Crossley Machine Co., Mammoth & Bell Sts., Trenton, N. J.
**CRUCIBLE STEEL CO. OF AMERICA, P. O. Box 2518, Pittsburgh 30, Pa. p312**
Cryogenerators, Inc., 750 S. Fulton Ave., Mount Vernon, N. Y.
**CUMMINS ENGINE CO., INC., 1000 Fifth St., Columbus, Ind. pp299, 300-301, 302-303, 304**
**CURTISS-WRIGHT CORP., Box 110, Princeton, N. J. p135**
Custom Assay Office, Box 811, El Paso, Tex.
Cutler-Hammer, Inc., 237 N. 12 St., Milwaukee 1, Wis.

# D

Dage Television Div., Thompson, Ramo, Wooldridge, Inc., West Tenth St., Michigan City, Ind.
Dagley Mfg. Co., 1217 E. Sixth St., Joplin, Mo.
Daniels, C. R., Inc., Daniels, Md.
Darling Valve & Mfg. Co., Foot of Walnut St., Williamsport, Pa.
Dart Union Co., 134 Thurbers Ave., Providence 5, R. I.
Davis Foundry & Machine Works, Old Furnace Road, Rome, Ga.
Day-Ray Products, Inc., 1133 Mission St., South Pasadena, Calif.
Daystrom, Inc., Weston Instruments Div., 614 Frelinghuysen Ave., Newark 12, N. J.
Dean Hill Corp., 4000 E. 16 St., Indianapolis 7, Ind.
**DEERE & CO., 3300 River Drive, Moline, Ill. pp68-69**
**DEISTER CONCENTRATOR CO., 903 Glasgow Ave., Ft. Wayne, Ind. p326**
**DEISTER MACHINE CO., 1933 E. Wayne St., Fort Wayne, Ind. p400**
Deming Co., 542 Broadway, Salem, Ohio.
Denver Equipment Co., Box 5268, Denver 17, Colo.
Denver Fire Clay Co., 3033 Blake St., Box 5510, Denver 17, Colo.
Derrick Mfg. Co., 590 Duke Rd., Buffalo 25, N. Y.
De Sousa, J. E., Co., Inc., 100 Church St., New York 7, N. Y.
Detroit Diesel Engine Div., General Motors Corp., 13400 W. Outer Dr., Detroit 28, Mich.
DeZurik Corp., Sartell, Minn.
Diamond Chain Co., Inc., 452 Kentucky Ave., Indianapolis 7, Ind.
**DIAMOND DRILL CONTRACTING CO., Station B, Box 4065, S. 18 Stone St., Spokane 31, Wash. p170**
Diamond Iron Works Div., Goodman Mfg. Co., Halsted St. & 48 Pl., Chicago 9, Ill.
Diamond Products Inc., 333 Prospect St., Elyria, Ohio
**DIAMOND, T. L., & CO., 1 Wall St., New York 5, N. Y. p400**
**DIAMOND TOOL RESEARCH CO., INC., 380 Second Ave., New York 10, N. Y. p398**
Dickinson Laboratories, Inc., 1300 W. Main St., Box 7006, El Paso, Texas
Diehl Mfg. Co., 1199 Finderne Ave., Somerville, N. J.
**DIESEL ENERGY CORP., 82 Beaver St., New York, N. Y. pp394-395**
Dietz, Henry G., Co. Inc., 12-16 Astoria Blvd., Long Island City 2, N. Y.
**DIFFERENTIAL STEEL CAR CO., Findlay, Ohio p360**
Dill Mfg. Co., 700 E. 82 St., Cleveland 3, Ohio.
**DINGS MAGNETIC SEPARATOR CO., 4716 W. Electric Ave., Milwaukee 46, Wisc. p334**
Dixon Valve & Coupling Co., Philadelphia 22, Pa.
Dodge Mfg. Corp., S. Union St., Mishawaka, Ind.
Dominion Engineering Co., Ltd., Box 220, Montreal, Quebec, Canada
**DORR OLIVER, INC., Havemeyer Lane, Stamford, Conn. pp8-9**
Dow Chemical Co., Midland, Mich.
Dow Corning Corp., Midland, Mich.
**DRAVO CORP., Neville Island, Pittsburgh 25, Pa. p391**
Dresser-Ideco Co., 975 Michigan Ave., Columbus 8, Ohio
Dresser Mfg. Div., Dresser Industries, Inc., Bradford, Pa.
**DROTT MFG. CORP., 3126 S. 27 St., Milwaukee 15, Wis.**
**DUCON CO., INC., 153 E. Second St., Mineola, N. Y. p62**
Duff Norton Co., 2709 Preble Ave., Pittsburgh 30, Pa.
**DuPONT DE NEMOURS & CO. INC., EXPLOSIVES DEPT., 2446 Nemours Bldg., Wilmington 98, Del. p36**
Durakool, Inc., 1010 N. Main St., Elkhart, Ind.
Duriron Co., Inc., 450 N. Findlay St., Dayton 4, Ohio.

# E

Eagle Iron Works, 262 Holcomb Ave., Des Moines 4, Iowa.
Eagle - Picher Co., American Bldg., Cincinnati 1, Ohio.
**EASTERN SALES CO., Box 1082, Pittsburgh 36, Pa. p390**
Eastern Steel Plate Fabricators, Inc., Foot of 40 Rd., Flushing, N. Y.
Eastman-Pacific Co., 5240 Alhambra Ave., Los Angeles 32, Calif.
Edison, Thomas A., Industries, McGraw-Edison Co., Storage Battery Div., West Orange, N. J.
Edward Valves, Inc., 1200 W. 145 St., East Chicago, Ind.
**EIMCO CORP., 634 S. 4 W., Box 300, Salt Lake City 10, Utah pp123, 125**
Elastic Stop Nut Corp. of America, 2330 Vauxhall Rd., Union, N. J.
Electric Machinery Mfg. Co., 800 Central Ave., Minneapolis 13, Minn.
ELECTRIC STEEL FOUNDRY CO., 214 **N. W. 25 Ave., Portland 10, Ore. pp165, 166**
**ELECTRIC STORAGE BATTERY CO., EXIDE INDUSTRIAL DIV., Rising Sun & Adams Ave., Philadelphia 20, Pa. p346**
**ELEKTROKEMISK A. S., 101 Park Ave., New York 17, N. Y. p364**
Elkhart Brass Mfg. Co., Inc. ,1302 W. Beardsley Ave., Elkhart, Ind.
**ELLICOTT MACHINE CORP., 1633 Bush St., Baltimore 30, Md. p396**
El Paso Testing Laboratory, Ltd., 2217 Texas St., Box 1565, El Paso, Texas.
Emerol Mfg. Co., Inc., 331 N. Main St., Port Chester, N. Y.
Emery Industries, Inc., Carew Tower, Cincinnati 2, Ohio.
Empire Steel Castings, Inc., Box 139, Reading, Pa.
Endicott Forging & Mfg. Co., 1901 North St., Endicott, N. Y.
Engelhard Industries, Inc., 113 Astor St., Newark, N. J.
Engineered Equipment, Inc., 1001 Linden Ave., Waterloo, Iowa.
**ENSING - BICKFORD CO., Simsbury, Conn. p55**
Enterprise Engine & Machinery Co., Box 949, San Francisco 10, Calif.
Enterprise Wheel & Car Corp., Bristol, Va.
**EQUIPMENT ENGINEERS, INC., 737 Loma Verde, Palo Alto, Calif. p323**
Equitable Paper Bag Co., Inc., 45-50 Van Dam St., Long Island City 1, N. Y.
Erie Pump & Engine Works, 144 Glenwood Ave., Medina, N. Y.
Erie Strayer Co., Erie, Pa.
**ERIEZ MFG. CO., 297 Magnet Dr., Erie, Pa. p406**
Essick Mfg. Co., 1950 Santa Fe Ave., Los Angeles 21, Calif.
Esso Standard Div., Humble Oil & Refining Co., 15 W. 51 St., New York 19, N. Y.
Esterline-Angus Co., Inc., Box 596, Indianapolis 6, Ind.
Ettco Wire & Cable Corp., 75 Onderdonk Ave., Brooklyn 37, N. Y.
**EUCLID DIV., GENERAL MOTORS CORP., 1361 Charden Rd., Cleveland 17, Ohio. p355**
Eutectic Welding Alloys Corp., 40-40 172 St., Flushing 58, N. Y.
Evanite Plastic Co., Evans Pipe Co., Carrollton, Ohio
Exolon Co., E. Niagara St., Tonawanda, N. Y.
Exploration Methods, Inc., Box 100, Ishpeming, Mich.
Extremultus, Inc., 25-11 40 Ave., Long Island City 1, N. Y.

# F

F. A. B. Mfg. Co., 1249—67 St., Oakland 8, Calif.
FWD Corp., 12 St., Clintonville, Wis.
Fafnir Bearing Co., 37 Booth St., New Britain, Conn.
Fagersta Steels, Inc., 5104 Chrysler Bldg., 405 Lexington Ave., New York 17, N. Y.
Failing, George E., Co., Enid, Okla.
**FAIRBANKS, MORSE & CO., 600 S. Michigan Ave., Chicago 5, Ill. p82**
Fairchild Aerial Surveys, Inc., 224 E. 11 St., Los Angeles, Calif.
Fairmont Machinery Co., Fairmont, W. Va.
Falcon Alarm Co., Inc., 243 Broad St., Summit, N. J.
**FALK CORP., 3049 W. Canal St., Milwaukee 1, Wis. p78**
Farr Co., Box 90187, Airport Station, Los Angeles 45, Calif.
Farris Corp., 400 Commercial Ave., Palisades Park, N. J.
Farris Flexible Valve Corp., 463 Commercial Ave., Palisades Park, N. J.
Farval Div., Eaton Mfg. Co., 3300 E. 80 St., Cleveland 4, Ohio.
**FATE-ROOT HEATH CO., Bell, High & Pine St., Plymouth, Ohio. p385**
Federal-Mogul Service Div., Federal-Mogul-Bower Bearings, Inc., 11031 Shoemaker, Detroit 13, Mich.
Federal Motor Truck Div., Napco Industries, Inc., 7th St.—N. Lyndale, Minneapolis 11, Minn.
Filtration Engineers Div., American Machine & Metals, Inc., East Moline, Ill.
**FIRESTONE TIRE & RUBBER CO., 1200 Firestone Parkway, Akron 17, Ohio. p44**
Firth Sterling, Inc., 3113 Forbes Ave., Pittsburgh 30, Pa.

Fisher Research Laboratory, Inc., 1975 University Ave., Palo Alto, Calif.
Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa.
**FISKE BROS. REFINING CO., LUBRI-PLATE DIV., 129 Lockwood St., Newark 5, N. J. p414**
Fletcher, J. H., & Co., 707 W. 7th St., Huntington, W. Va.
**FLEXAUST CO., 100 Park Ave., New York 17, N. Y. p411**
**FLEXIBLE STEEL LACING CO., 4607 Lexington St., Chicago 44, Ill. p408**
Flexible Tubing Co., Guilford, Conn.
Flexo Products, Inc., 24864 Detroit Rd., Westlake, Ohio
Flocker, John, & Co., 644 Grant St., Pittsburgh 19, Pa.
Flood City Brass & Electric Co., Johnstown, Pa.
**FLYGT CORP., Hoosick Falls, N. Y. p350**
Foley Brothers, Inc., Pleasantville, N. Y.
Food Machinery & Chemical Corp., Mineral Products Div., Chlor-Alkali Div., 161 E. 42 St., New York 17, N. Y.
Foote Bros. Gear & Machine Corp., Whitney Chain Co., 4545 S. Western Blvd., Chicago 9, Ill.
Ford Motor Co., Box 658, Dearborn, Mich.
Foker Corp., 2044 Random Rd., Cleveland 6, Ohio
Foster, L. B., Co., Box 1647, Pittsburgh 30, Pa.
**FOXBORO CO., Foxboro, Mass. p140**
Fram Corp., 105 Pantucket Ave., E. Providence, R. I.
Frank, M. K., 480 Lexington Ave., New York 17, N. Y.
Frazier Davis Construction Co., 1319 Macklind Ave., St. Louis, Mo.
Freeport Sulphur Co., 161 E. 42 St., New York, N. Y.
Frog, Switch & Mfg. Co., Carlisle, Pa.
Fuller Co., Catasauqua, Pa.
Fyr-Fyter Co., 221 Crane St., Dayton 1, Ohio

Geophysical Specialties Co., 15409 Robinwood Dr., Hopkins, Minn.
**GEORGIA IRON WORKS CO., 605 12th St., Augusta, Ga.**
Getman Brothers, U. S. 31, South Haven, Mich.
Gilson Screen Co., 110 Center St., Malinta, Ohio
Gladding, McBean & Co., 2901 Los Feliz Blvd., Los Angeles 39, Calif.
Godoy, E. A., & Co., Inc., 25 Broadway, New York 4, N. Y.
Goldak Co., Inc., 1544 W. Glenoaks Blvd., Glendale 1, Calif.
Golden-Anderson Valve Specialty, 1232 Ridge Ave., Pittsburgh 33, Pa.
Goodall Brothers, 46 S. Main St., Box 537, Helena, Mont.
Goodall Rubber Co., Whitehead Rd., Trenton, N. J.
Goodman Mfg. Co., Halsted St. & 48th Pl., Chicago 9, Ill.
**GOODRICH, B. F., AVIATION PRODUCTS, 500 S. Main St., Akron, Ohio p70**
**GOODRICH, B. F. CO., TRUCK & BUS TIRE DEPT., 500 S. Main St., Akron 18, Ohio p29**
**GOODRICH, B. F., INDUSTRIAL PRODUCTS CO., 500 S. Main St., Akron 18, Ohio p3**
**GOODYEAR TIRE & RUBBER CO., 1144 E. Market St., Akron 16, Ohio pp10-11, 15**
Gorman Rupp Co., Mansfield, Ohio
**GOULD, GORDON I., CO., 58 Sutter St., San Francisco 4, Calif. p432**
**GOULD-NATIONAL BATTERIES INC., Trenton 7, N. J. p154**
Goulds Pumps, Inc., Seneca Falls, N. Y.
Graver Water Conditioning Co., Union Tank Car Co., Div., 216 W. 14 St., New York 11, N. Y.
Gray & Co., Inc., 60—11 Ave., N. E. Minneapolis 13, Minn.
Green Fire Brick Co., Mexico, Mo.
Greene, Tweed & Co., North Wales, Pa.
Greenville Steel Car Co., Greenville, Pa.
Grinnell Co., Inc., 260 W. Exchange St., Providence 1, R. I.
Gulf Oil Corp., Dept. DM Gulf Bldg., Box 1166, Pittsburgh 30, Pa.
Gundlach Machine Co., JMJ Industries, Inc., Box 283, Belleville, Ill.
Gurley, W. & L. E., 514 Fulton St., Troy, N. Y.
Gustin-Bacon Mfg. Co., 210 W. 10 St., Kansas City, Mo.
Guyan Machinery Co., 755 Stratton, Logan, W. Va.

Haynes Stellite Co., Div., Union Carbide Corp., Kokomo, Ind.
Hays Corp., 742 E. 8 St., Michigan City, Ind.
Heil Co.—TEC Div., 1285 W. 70 St., Cleveland 2, Ohio
Heintz Mfg. Co., 13110 Enterprise Ave., Cleveland 35, Ohio
Helwig Co., 2550 N. 30 St., Milwaukee 10, Wis.
**HENDRICK MFG. CO., Carbondale, Pa. p187**
Hendrix Mfg. Co., Box 31, Mansfield, La.
Hercules Motors Co., 101-11 St., S. E. Canton, Ohio
**HERCULES POWDER CO., 933 King St., Wilmington, Del. p136**
Hercules Steel Products Co., Galion, Ohio
Hertner Electric Co., 12690 Elmwood Ave., N. W. Cleveland 11, Ohio
Hevi-Duty Electric Co., 304 Hart St., Watertown, Wis.
**HEWITT-ROBINS, INC., 666 Glenbrook Rd., Stamford, Conn. p401**
Hillman, C. Kirk, Co., Inc., 3201 First Ave., S., Seattle 4, Wash.
Hobart Bros. Co., Main & Adams Sts., Troy 1, Ohio
**HOFFMAN BROS. DRILLING CO., Tiona St. Ext., Punxsutawney, Pa. p405**
Homelite Corp., 75 Riverdale Ave., Port Chester, N. Y.
Hood Industrial Gloves, Watertown 72, Mass.
Hoover Ball & Bearing Co., Box 1607, 5400 S. State Rd., Ann Arbor, Mich.
Hose Accessories Co., 17 St. & Lehigh Ave., Philadelphia 32, Pa.
Hossfeld Mfg. Co., Winona, Minn.
Hough, Frank G., Co., 726 Seventh St., Libertyville, Ill.
Howe Scale Co., American Mfg. Co., Inc., Rutland, Vt.
Howell Electric Motors Co., 409 N. Roosevelt St., Howell, Mich.
Hoyt Wire Cloth Co., Box 1577, Lancaster, Pa.
**HUBER-WARCO CO., Marion, Ohio p149**
Hughes Tool Co., 5425 Polk St., Box 2539, Houston, Texas.
Hulburt Oil & Grease Co., Trenton & Castor Aves., Philadelphia 34, Pa.
Humphreys Engineering Co., Room 910, 818-17th St., American National Bank Bldg., Denver 2, Colo.
Hunting Survey Corp., Ltd., 1450 O'Connor Dr., Toronto 16, Canada
Hunting Surveys, Inc., 10 Rockefeller Plaza, New York 20, N. Y.
Hunting Surveys, Ltd., 6 Elstree Way Boreham Wood, London, England
Hypro Engineering, Inc., 700 39 Ave., N. E. Minneapolis 21, Minn.
Hyster Co., 2902 N. E. Clackamas St., Box 4318, Portland 8, Ore.

# G

**G & W ELECTRIC SPECIALTY CO., 3500 W. 127 St., Blue Island, Ill. p161**
Galigher Co., Box 209, Salt Lake City 10, Utah
Galion Allsteel Body Co., Galion, Ohio
Galion Iron Works, Galion, Ohio
Galland Henning Mfg., Co., Nopak Div., 2753 S. 31 St., Milwaukee 46, Wisc.
Gar Wood Industries, Inc., Wayne, Mich.
**GARDNER DENVER CO., Quincy, Ill. p76-77**
Garlock Inc., 402 E. Main St., Palmyra, N. Y.
Gates Engineering Co., 100 S. West St., Wilmington 99, Del.
**GATES RUBBER CO., 999 S. Broadway, Denver 17, Colo. p356**
**GENERAL AMERICAN TRANSPORTATION COPR., 135 S. LaSalle St., Chicago 3, Ill. p319**
General Cable Corp., 730 Third Ave., New York 17, N. Y.
General Chemical Div., Allied Chemical Corp., 40 Rector St., New York 6, N. Y.
General Electric Co., Apparatus Sales Div., Schenectady 5, N. Y.
General Electric Co., Gear Motor & Transmission Components Dept., 845 E. 25 St., Paterson, N. J.
**GENERAL MOTORS CORP., ALLISON DIV., 4700 W. 10 St., Indianapolis 6, Ind. p363**
General Motors Corp., Hyatt Bearings Div., 427 Middlesex St., Harrison, N. J.
**GENERAL TIRE & RUBBER CO., 1708 Englewood Ave., Akron, Ohio p339**
Geo Optic & Paper Corp., 149 Church St., New York 7, N. Y.
Geodimeter Co., 2013 Park Ave., South Plainfield, N. J.
**GEODYNAMICS, INC., 10809½ Strathmore Dr., Los Angeles 24, Calif.**
Geophysical Instrument & Supply, 1616 Broadway, Denver 2, Colo.

# H

Hack Engineering Co., 124 Wazee Market, Denver, Colo.
Hagan Chemicals & Controls Inc., Calgon Co., Hall Laboratories, Hagan Center, Pittsburgh 30, Pa.
**HALLIBURTON OIL WELL CEMENTING, Duncan, Okla. p83**
**HAMMERMILLS, INC., 625 C Ave., N.W., Cedar Rapids, Iowa p432**
Hammond, J. V., Co., Spangler, Pa.
Hanks, Abbot A., Inc., 1300 Sansome St., San Francisco 11, Calif.
**HARBISON-WALKER REFRACTORIES CO., 307 Fifth Ave., Pittsburgh 22, Pa. pp152-153**
**HARDINGE CO., INC., 240 Arch St., York, Pa. pp324-325**
**HARNISCHFEGER CORP., 4400 W. National Ave., Milwaukee 46, Wis. pp64-65**
Harrington Co., Gravers Rd., at the Turnpike, Plymouth Meeting, Pa.
Hartzell Propeller Fan Co., Box 909, Piqua, Ohio
Hauck Mfg. Co., Equipment Div., 124-136 10 St., Brooklyn 15, N. Y.
Hauser-Stander Tank Co., 4820 Spring Grove Ave., Cincinnati 32, Ohio
Havlick, J. L., 112 S. Cedar St., Spokane, Wash.
Hawley & Hawley Assayers & Chemists Inc., Box 1060, Douglas, Ariz.
Hawthorne, Inc., Box 7366, Houston 8, Texas

# I

ITT Federal Div., International Tel. & Tel. Corp., 100 Kingsland Rd., Clifton, N. J.
Ideal Electric & Mfg. Co., Mansfield, Ohio
Ideal Industries, Inc., 1020 Park Ave., Sycamore, Ill.
Illinois Gear & Machine Co., 2108 N. Natchez Ave., Chicago 35, Ill.
Imperial-Cantrell Mfg. Co., Box 538, Jellico, Tenn.
Imperial Oil & Grease, 6505 Wilshire Blvd., Los Angeles, Calif.
Industrial Air Products Co., 3200 N. W. Yeon Ave., Portland 10, Ore.
Industrial Engineering & Construction Co., First National Bank Bldg., Fairmont, W. Va.
Industrial Nucleonics Corp., 650 Ackerman Rd., Columbus 2, Ohio
**INDUSTRIAL PHYSICS & ELECTRONICS, 470 S. 10 E., Salt Lake City 2, Utah p322**
Infilco, Inc., 901 S. Campbell Ave., Tucson, Ariz.

**INGERSOLL-RAND CO. 11 Broadway, New York 4, N. Y. p1**
**INTERNATIONAL BARTERING CO., 52 Broadway, New York, N. Y. p412**
**INTERNATIONAL HARVESTER CO., MOTOR TRUCK DIV., 180 N. Michigan Ave., Chicago 1, Ill. pp313, 314-315, 316-317, 318**
**INTERNATIONAL NICKEL CO., 67 Wall St., New York 5, N. Y. p134**
International Rectifier Corp., 23 Kansas St., El Segundo, Calif.
Interstate Drop Forge Co., Special Products Div., 4051 N. 27 St., Milwaukee 16, Wisc.
Interstate Equipment Corp., 433 N. Broad St., Elizabeth 3, N. J.
Intrusion-Prepakt Inc., 568 Union Commerce Bldg., Cleveland 14, Ohio
Ionics Inc., 152 Sixth St., Cambridge 42, Mass.
**IOWA MFG. CO., 916 16 St., N. E. Cedar Rapids, Iowa p143**
Ironton Engine Co., Farmingdale, N. J.
Irving Subway Grating Co., Inc., 50-99 27th St., Long Island City 1, N. Y.
Irwin Sensenich Corp., Box 311, Irwin, Pa.

# J

Jaeger Machine Co., 550 W. Spring St., Columbus 16, Ohio
Jarrell-Ash Co., 28 Farwell St., Newtonville 60, Mass.
Jeffrey Mfg. Co., 886 N. 4th St., Columbus 16, Ohio
**JENKINS BROS., 100 Park Ave., New York 17, N. Y. p117**
Jet-Lube, Inc., 3093 N. California St., Burbank, Calif.
**JOHNS-MANVILLE, 22 E. 40 St., New York 16, N. Y. p413**
Johns-Manville Plastics Corp., 315 Grant St., Franklin, Pa.
Johnson Corp., 882 Wood St., Three Rivers, Mich.
Johnson Loading Supplies, 5027 Butterworth Rd., Mercer Island, Wash.
Johnston-Morehouse-Dickey Co., 704 Second Ave., Pittsburgh 19, Pa.
Johnston Pump Co., Youngstown Sheet & Tube Co., 3272 E. Foothill Blvd., Pasadena 8, Calif.
Jones & Laughlin Steel Corp., 3 Gateway Center, Pittsburgh 30, Pa.
**JOY MFG. CO., Henry W. Oliver Bldg., Pittsburgh 22, Pa. pp45, 46-47, 48, 412**

# K

**KW-DART TRUCK CO., 1301 N. Manchester Trfwy., Kansas City 20, Mo. p343**
Kaiser Aluminum & Chemical Sales, Kaiser Center, Oakland 12, Calif.
**KAISER ENGINEERS, Kaiser Center, Oakland, Calif. p127**
Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales Inc., 300 Lakeside Dr., Oakland 12, Calif.
Kansas City Hay Press, 801 Woodswether Rd., Kansas City, Mo.
Kaydon Engineering Corp., Muskegon, Mich.
Keasbey & Mattison Co., Amber, Pa.
Keeler, E., Co., 238 West St., Williamsport 3, Pa.
**KELLOGG, M. W., CO., DIV. PULLMAN, INC., 711 Third Ave., New York 17, N. Y. pp12-13**
Kelly-Springfield Tire Co., Box 300, Cumberland, Md.
Kenco Pump Div., American Crucible Products Co., 1305 Oberlin Ave., Lorain, Ohio
Kennametal Inc., Mining Tool Div., Bedford, Pa.
Kennedy Valve Mfg. Co., Elmira, N. Y.
**KENNEDY VAN SAUN MFG. & ENG. CORP., 405 Park Ave., New York 22, N. Y. p180**
Kenworth Motor Truck Co., Div., Pacific Car & Foundry Co., 8801 E. Marginal Way, Seattle 24, Wash.
Kern Instruments, Inc., 120 Grand St., Box 727, White Plains, N. Y.
Kersey Mfg. Co., Inc., Box 151, Blufield, Va.
Keystone Lubricating Co., 21 & Clearfield Sts., Philadelphia 32, Pa.
Keystone Valve Corp., Box 6716, 5325 Kirby Dr., Houston 5, Texas
Kidde & Co., Inc., 956 Main St., Belleville 9, N. J.
KIN TEL, 5725 Kearny Villa Rd., San Diego, Calif.
Kloeckner-Humboldt-Deutz AG, Cologne, Germany
Knox Mfg. Co., 222 W. Clinton Ave., Oaklyn, N. J.
Koebel Diamond Tool Co., 9456 Grinnell, Detroit 13, Mich.
Koehring Co., 3026 W. Concordia, Milwaukee 16, Wisc.
Koppers Co., Inc., Koppers Bldg., Pittsburgh 19, Pa.
Koppers Co., Inc., Metal Prod. Div., 200 Scott St., Baltimore 30, Md.
Korfund Co., Inc., 48—15 32nd Place, Long Island City, N. Y.
Krogh Pump & Equipment Co., Inc., 515 Harrison St., San Francisco 5, Calif.
Kuhlman Electric Co., Box 288, Birmingham, Mich.

# L

Laboratory Equipment Corp., Lakeview & Hilltop, St. Joseph, Mich.
Ladish Co., 5481 S. Packard Ave., Cudahy, Wis.
Lake Shore Inc., Lake Shore Engineering Div., Iron Mountain, Mich.
Lakeside Bridge & Steel Co., 5306 N. 33 St., Milwaukee 9, Wisc.
Lamson & Sessions Co., 5000 Tiedeman Rd., Cleveland 9, Ohio
Lancaster Pump & Mfg. Co., Lancaster, Pa.
Laubenstein Mfg. Co., 422 S. Third St., Ashland, Pa.
Lawrence Pumps, Inc., 371 Market St., Lawrence, Mass.
Layne & Bowler Pump Co. of L. A., 2943 S. Vail Ave., Los Angeles 22, Calif.
Lebanon Steel Foundry, Lebanon, Pa.
Lectromelt Furnace Div., McGraw Edison Co., Box 1257, Pittsburgh 30, Pa.
Ledeen Mfg. Co., 3350 N. Gilman Rd., El Monte, Calif.
Ledoux & Co., Inc., 359 Alfred Ave., Teaneck, N. J.
Leeds & Northrup Co., 4970 Stenton Ave., Philadelphia 44, Pa.
Lehigh Fan Div., Fuller Co., Catasauqua, Pa.
Leland Ohio Electric Co., Howell Electric Motors Co., 1501 Webster St., Dayton 4, Ohio
**LeROI DIV., WESTINGHOUSE AIR BRAKE CO., Milwaukee 1, Wis. pp150-151**
**LESCHEN WIRE ROPE DIV., H. K. PORTER CO., INC., 2727 Hamilton Ave., St. Louis 12, Mo. pp322, 334, 373, 406**
**LeTOURNEAU INC., 2390 S. MacArthur St., Longview, Texas**
**LeTOURNEAU - WESTINGHOUSE CO., Box 240, Peoria, Ill. pp30-31**
Lidgerwood Mfg. Co., 7 Day St., New York, N. Y.
**LINATEX CORP. OF AMERICA, Stafford Springs, Conn. p367**
Lincoln Electric Co., 22801 St. Clair Ave., Cleveland 17, Ohio
Lincoln Engineering Co., Div. McNeil Machine & Engineering Co., 4010 Goodfellow Blvd., St. Louis 20, Mo.
Linde Co., Union Carbide Corp., 270 Park Ave., New York 17, N. Y.
Line Material Industries, McGraw-Edison Co., 700 W. Michigan St., Milwaukee 1, Wis.
**LINK-BELT CO., Dept. EMJ-60, Prudential Plaza, Chicago 1, Ill. p157**
Link-Belt Speeder Corp., 1201-6 St., S. W. Cedar Rapids, Iowa
Lippmann Engineering Works Inc., 4603 W. Mitchell St., Milwaukee, Wis.
Lister-Blackstone Inc., 42-32 21st St., Long Island City 1, N. Y.
**LOGAN ENGINEERING CO., 4901 W. Lawrence Ave., Chicago 30, Ill. p392**
Lombard Governor Corp., Main St., Ashland, Mass.
Long-Airdox Co., Marmon-Herrington Inc., 307 N. Michigan Ave., Chicago 1, Ill.
**LONGYEAR CO., 1700 Foshay Tower, Minneapolis 2, Minn. p411**
Louden Machinery Co., 607 Broadway, Fairfield, Iowa
Lovejoy Flexible Coupling Co., 4932 W. Lake St., Chicago 44, Ill.
Lufkin Rule Co., 1730 Hess Ave., Saginaw, Mich.
Lukens Steel Co., Coatesville, Pa.
Lundberg Explorations Ltd., 96 Eglinton Ave., E. Toronto, Ontario, Canada
Lunkenheimer Co., Beekman St. & Waverly Ave., Cincinnati 14, Ohio
Luzerne Rubber Co., Muirhead & Dewey Sts., Trenton 7, N. J.

# M

**MACHINERY CENTER INC., Box 964, 1201 S. 8 S. Salt Lake City 10, Utah p366**
**MACK TRUSKS INC., 1355 W. Front St., Plainfield, N. J. pp40-41**
Macklin Co., 2917 Wildwood Rd., Jackson, Mich.
Macwhyte Wire Rope Co., 2937 14th St., Kenosha, Wisc.
Magnaflux Corp., 7328 W. Lawrence Ave., Chicago 31, Ill.
Magnetic Engineering & Mfg. Co., 852 Van Houten Ave., Clifton, N. J.
**MAGOR CAR CORP., 50 Chruch St., New York 7, N. Y. p141**
Majac Inc., 23rd St., Sharpsburg, Pittsburgh 15, Pa.
**MANCHA STORAGE BATTERY LOCOMOTIVE DIV., GOODMAN MFG. CO., Halsted St. & 48 Place, Chicago 9, Ill. p37**
Manganese Steel Forge Co., Richmond & Castor Ave., Philadelphia, Pa.
Manheim Mfg. & Belting Co., 470 Stiegel St., Manheim, Pa.
**MANITOWOC ENGINEERING CORP., S. 16 St., Manitowoc, Wisc.**
Manning, Maxwell & Moore Inc., Shaw Box Crane & Hoist Div., Muskegon, Mich.
Manzel Div., Houdaille Industries Inc., 315 Babcock St., Buffalo 10, N. Y.
Marathon Div., American Can Co., Chemical Sales Dept., Menasha, Wisc.
Marathon Electric Mfg. Corp., Wausau, Wisc.
Marble Electric Corp., Superior St., Gladstone, Mich.
Marietta Concrete Div., American-Marietta Co., Box 669, Dept. B, Marietta, Ohio
**MARION METAL PRODUCTS CO., Cheney Ave., Marion, Ohio**
**MARION POWER SHOVEL CO., UNIVERSAL MARION CORP., Marion, Ohio p75**
Markley Dust Control System Inc., 80 Snyder Rd., Ramsey, N. J.

Marland One-Way Clutch Co., Elm Ave. & Washington St., La Grange, Ill.
Marlin-Rockwell Corp., 402 Chandler St., Jamestown, N. Y.
Marlow Pumps Div., Bell & Gossett Co., Box 200, Midland Park, N. J.
Marquette Mfg. Co., Inc., 307 E. Hennepin Ave., Minneapolis 14, Minn.
Martin Engineering Co., Neponset, Ill.
Master Builders Co., 7016 Euclid Ave., Cleveland 3, Ohio
Mayhew Machine & Supply Co., Box 7726, Dallas, Texas
**MAYO TUNNEL & MINE EQUIPMENT, Box 1413, Lancaster, Pa. p415**
McClintock Co., W. 418 Second Ave., Spokane, Wash.
McCulloch Corp., Chain Saw Div., 6101 W. Century Blvd., Los Angeles 45, Calif.
McDowell Co. Inc., Wellman Engineering Co., 113 St. Clair Ave., N. E. Cleveland 14, Ohio
McKay Co., 1005 Liberty Ave., Pittsburgh, Pa.
**McLANAHAN & STONE CORP., Hollidaysburg, Pa. p365**
**McNALLY PITTSBURG MFG. CORP., 307 W. Third St., Pittsburg, Kan. p337**
McPhar Geophysics Ltd., 139 Bond Ave., Don Mills, Ontario, Canada
Meckum Engineering Inc., Dayton Rd., Ottawa, Ill.
Meehanite Corp., 714 North Ave., New Rochelle, N. Y.
Megator Corp., 930 Machester Ave., Pittsburgh 12, Pa.
Mercer Rubber Co., Hamilton Square, N. J.
**MERRICK SCALE MFG. CO., 184 Autumn St., Passaic, N. J.p405**
Metal Carbides Corp., 6001 Southern Blvd., Youngstown 12, Ohio
Metal Goods Corp., 8800 Page Blvd., St. Louis 66, Mo.
Metallizing Engineering Co. Inc., 1101 Prospect Ave., Westbury, N. Y.
Metallurgical Products Dept., General Electric Co., 11177 E. Eight Mile Rd., Detroit 32, Mich.
Metron Instrument Co., 432 Lincoln St., Denver, Colo.
Midwestern Engine & Equipment Co., Box 1886, Tulsa, Okla.
Miller, David, & Associates, Box 572, Beverly Hills, Calif.
Miller Electric Mfg. Co., Box 798, Appleton, Wisc.
Miller Equipment Co. Inc., 13 & New Sts., Franklin, Pa.
**MINE SAFETY APPLIANCES CO., 201 N. Braddock Ave., Pittsburgh 8, Pa. p121**
**MINE & SMELTER SUPPLY CO., Box 9041 Denver 16, Colo. pp372-373**
Minerals Engineering Co., 801 Fourth Ave., Grand Junction, Colo.
Minneapolis-Honeywell Rgulator, 2753 Fourth Ave., S., Minneapolis 8, Minn.
Minneapolis - Honeywell Regulator, Brown Instrument Div., Wayne & Windrim Ave., Philadelphia 44, Pa.
Minnesota Mining & Mfg. Co., 900 Bush Ave., St. Paul 6, Minn.
**MISSION MFG. CO., Box 4209, Houston, Texas p115**
**MIXING EQUIPMENT CO., 234 Mt. Read Blvd., Rochester 3, N. Y. p407**
Mobile Aerial Towers Inc., Ft. Wayne, Ind.
**MOBILE DRILLING INC., 560 N. Pennsylvania St., Indianapolis 4, Ind. p344**
Moloney Electric Co., 5390 Bircher Blvd., St. Louis 20, Mo.
Moore Co., 424 Nichols Rd., Kansas City 12, Mo.
Moran Instrument Co., 170 E. Orange Grove, Pasadena, Calif.
Morehouse-Cowles Inc., 1156 San Fernando Rd., Los Angeles 31, Calif.
**MORRIS MACHINE WORKS, Baldwinsville, N. Y. p389**
**MORSE BROS. MACHINERY CO., 2900 Brighton Blvd., Box 1708, Denver, Colo. p396**
Morse Chain Co., Borg-Warner Industry, Ithaca, N. Y.
Motoramic Inc., 2120 Market St., San Francisco 14, Calif.
Motorola Communications & Electronics Inc., 4501 Augusta Blvd., Chicago 51, Ill.
Mueller Co., 512 W. Cerro Gordo St., Decatur, Ill.
Multi-Metal Wire Cloth Co. Inc., 1349 Garrison Ave., New York 59, N. Y.
Murphy Diesel Co., 5317 W. Burnham St., Milwaukee 11, Wisc.
Myers-Whaley Co. Inc., Box 789, Knoxville 1, Tenn.

# N

**NACHOD & U. S. SIGNAL CO., 4777 Louisville Ave., Louisville 9, Ky. p431**
**NAGLE PUMPS INC., 1239 Center St., Chicago Heights, Ill. p398**
Naico Chemical Co., 6216 W. 66 Place, Chicago 38, Ill.
Nash Engineering Co., 218 Wilson Rd., South Norwalk, Conn.
National Carbon Co., Union Carbide Corp., 270 Park Ave., New York 17, N. Y.
National Electric Div., H. K. Porter Co., Inc., Porter Bldg., Pittsburgh 19, Pa.
**NATIONAL FILTER MEDIA CORP., 1717 Dixwell Ave., New Haven 11, Conn. p336**
National Fuse & Powder Co., 3801 Delgany St., Denver 5, Colo.
**NATIONAL IRON CO., Ramsey St. & 50 Ave. W. Duluth 7, Minn. p351**
National Lock Washer Co., 40 Herman Ave., Newark, N. J.
**NAT'L MALLEABLE & STEEL CASTINGS, CAPITOL FOUNDRY DIV., Phoenix, Ariz. pp43, 329**
**NATIONAL MINE SERVICE CO., 2530 Koppers Bldg., Pittsburgh 19, Pa. p137**
National Powder Co., Eldred, Pa.
National Standard Co., Eight & Howard, Niles, Mich.
National Supply Co., 2 Gateway Center, Pittsburgh, Pa.
National Tank & Pipe Co., 2301 N. Columbia Blvd., Portland 3, Ore.
**NAYLOR PIPE CO., 1243 E. 92 St., Chicago 19, Ill. p374**
New Departure Div., General Motors Corp., Bristol, Conn.
New York Air Brake Co., Aurora Pump Div., 88 Laucks St., Aurora, Ill.
**NEW YORK ENGINEERING CO., 75 West St., New York 6, N. Y. p414**
Newark Wire Cloth Co., 370 Verona Ave., Newark 4, N. J.
Newport Industries Co., Heyden Newport Chemical Corp., 342 Madison Ave., New York 17, N. Y.
Nice Ball Bearing Co., 30th & Hunting Park Ave., Philadelphia 40, Pa.
**NICHOLS ENGINEERING & RESEARCH Corp., 70 Pine St., New York 5, N. Y.**
Nichols Laboratories Inc., 160 S. West Temple, Salt Lake City 1, Utah
Nolan Co., 120 Pennsylvania St., Bowerston, Ohio
**NORDBERG MFG. CO., 3073 S. Chase Ave., Milwaukee 1, Wisc. pp172-173, 174-175, 375**
Norma-Hoffman Bearings Corp., Stamford, Conn.
North American Gear Co., Box 7, Blairsville, Pa.
**NORTHERN BLOWER DIV., BUELL ENGINEERING CO. INC., 6410 Barberton Ave., Cleveland, Ohio p128**
Northern Conveyor Co., Box 46, Janesville, Wisc.
Northwest Engineering Co., 135 S. LaSalle St., Chicago 3, Ill.
Norton Co., 1 New Bond St., Worcester 6, Mass.

# O

**OHIO BRASS CO., Mansfield, Ohio p155**
OPW-Jordan Corp., 6013 Wiehe Rd., Cincinnati 13, Ohio
Ogden Iron Works Co., 185 23 St., Box 147, Ogden, Utah
Ohio Carbon Co., 12508 Berea Rd., Cleveland 11, Ohio
Ohio Gear Co., 1333 E. 179 St., Cleveland 10, Ohio
Ohio Injector Co., 275 Main St., Wadsworth, Ohio
Ohio Oil Co., 539 S. Main St., Findlay, Ohio
Ohmart Corp., 2236 Bogen St., Cincinnati 22, Ohio
Oilgear Co., 1560 W. Pierce St., Milwaukee 4, Wisc.
Okonite Co., 220 Passaic St., Passaic, N. J.
Olds Alloy Co., 4481 Mason St., South Gate, Calif.
Oliver Corp., 400 W. Madison, Chicago 6, Ill.
Onan, D. W., & Sons, Inc., University Ave. S. E. at 25th, Minneapolis 14, Minn.
Onyx Chemical Corp., 190 Warren St., Jersey City 2, N. J.
Orange Roller Bearing Co., 555 Main St., Orange, N. J.
Ore & Chemical Corp., 80 Broad St., New York, N. Y.
Orton Crane & Shovel Co., 608 S. Dearborn St., Chicago 5, Ill.
Oshkosh Motor Truck Inc., 2300 Oregon St., Oshkosh, Wisc.
Osmose Wood Preserving Co., 980 Ellicott St., Buffalo 9, N. Y.
Overstrom & Sons Inc., 2213 W. Mission Rd., Alhambra, Calif.
Owatonna Tool Co., 655 Cedar St., Owatonna, Minn.
Owen Bucket Co., 6001 Breakwater Ave., Cleveland 2, Ohio
Oxy-Catalyst Inc., 511 Old Lancaster Rd., Berwyn, Pa.

# P

PIM Products Inc., 3871 W. 150 St., Cleveland 11, Ohio
Pacific Coast Engineering Co., Oak & Clement Sts., Alameda, Calif.
Pacific Lumber Co., 100 Bush St., San Francisco 4, Calif.
Pacific Wood Tank Div., Sauers Forest Products Inc., Box 188, Healdsburg, Calif.
Packsack Diamond Drills Ltd., 1385 Hammond St., North Bay, Ontario, Canada
Page Engineering Co., Clearing Post Office, Chicago 38, Ill.
Palnut Co., United-Carr Fastener Corp., Glen Rd., Mountainside, N. J.
Paragon Electric Co., 1600 12 St., Two Rivers, Wisc.
Paragon - Revolute, Charles Bruning Co. Inc., 77 South Ave., Rochester 4, N. Y.
Parker-Hannifin Corp., 17325 Euclid Ave., Cleveland 12, Ohio
Parkersburg Rig & Reel Co., 620 Depot St., Parkersburg, W. Va.
**PARTS, INC., Box 48, Sugarhouse Sta., Salt Lake City 6, Utah p408**
Pattin Mfg. Co., Box 659, Marietta, Ohio
Peerless Photo Products Inc., Shoreham, N. Y.
Peerless Pump, Hydrodynamics Div., Food Machinery & Chemical Corp., 301 West Ave. 26, Los Angeles 31, Calif.
Pendleton Woolen Mills, Box 655, Washougal, Wash.
Penn Machine Co., 905 H. K. Porter Bldg., Pittsburgh 19, Pa.
Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia 2, Pa.
Pennsylvania Crusher Div., Bath Iron Works Corp., 232 South Matlack St., West Chester, Pa.
Pennsylvania Pump & Compressor Co., Easton, Pa.
Perkin Engineering Corp., 345 Kansas St., El Segundo, Calif.
Permutit Co. Div., Pfaudler Permutit Inc., 50 W. 44 St., New York 36, N. Y.
**PETERSON FILTERS & ENGINEERING CO., 1949 S. 2 W., Box 606, Salt Lake City 10, Utah p142**
Pettibone Mulliken Corp., 4710 W. Division St., Chicago 51, Ill.
**PHELPS DODGE COPPER PRODUCTS, 300 Park Ave., New York 22, N. Y. p161**
**PHELPS DODGE REFINING, 300 Park Ave., New York 22, N. Y. p380**

Philadelphia Gear Corp., King of Prussia, Pa.
**PHILADELPHIA QUARTZ CO., 1135 Public Ledger Bldg., Philadelphia 6, Pa. p411**
Philips Electronic Instruments, 750 S. Fulton Ave., Mt. Vernon, N. Y.
Phillips Petroleum Co., Bartlesville, Okla.
Phoenix Products Co., 4715 N. 27 St., Milwaukee, Wisc.
Pickard Industries Inc., Central Mine Supply Co. Div., Mt. Vernon, Ill.
Pioneer Engineering Div., Poor & Co. Inc., 3200 Como Ave., Minneapolis 14, Minn.
Pipe Linings Inc., Box 457, Wilmington, Calif.
Pittsburgh Corning Corp., 1 Gateway Center, Pittsburgh 22, Pa.
Pittsburgh Gear Co., Neville Island, Pittsburgh 25, Pa.
Plasteel Products Co., 15 McAdam Ave., Washington, Pa.
Porto Pump Inc., 19735 Ralston, Detroit 3, Mich.
Porter-Cable Machine Co., 700 Marcellus St., Syracuse 4, N. Y.
Frederick Post Co., 3650 N. Avondale Ave., Chicago 18, Ill.
Powell, William, Co., 2525 Spring Grove Ave., Cincinnati 22, Ohio
Precision Grinding Wheel Co. Inc., 8301 Torresdale Ave., Philadelphia 36, Pa.
Precision Radiation Instruments 5810 S. Normandie, Los Angeles 44, Calif.
Precision Thermometer & Instrument Co., 1434 Brandywine St., Philadelphia 30, Pa.
Preco Inc., 6300 E. Slauson Ave., Los Angeles 22, Calif.
Prime Mover Co., Muscatine, Iowa
Productive Equipment Corp., 2926 W. Lake St., Chicago 12, Ill.
Proto Tool Div., Pendleton Tool Industries, 2209 Santa Fe Ave., Los Angeles 54, Calif.
Pulmosan Safety Equipment Corp., 644 Pacific St., Brooklyn, N. Y.
Pulva Corp., 602 High St., Perth Amboy, N. J.
Purolator Products Inc., 970 New Brunswick Ave., Rahway, N. J.

# Q—R

Quick-Way Truck Shovel Co., Box 1800, Denver 1, Colo.
Radio Corp. of America, Communications Products Dept., Camden 2, N. J.
Rail & Industrial Equipment Co. Inc. 32 Church St., New York 7, N. Y.
**RAYBESTOS-MANHATTAN INC., MANHATTAN RUBBER DIV., 42 Townsend St., Passaic, N. J. pp88-89**
Ray-O-Vac Co., 212 E. Washington Ave., Madison 10, Wisc.
Reading Crane & Hoist Corp., Box 1139, Reading, Pa.
Ready Power Co., 11231 Freud Ave., Detroit, Mich.
Red Jacket Co. Inc., 500 Bell Ave., Carnegie, Pa.
Reichdrill Div., Chicago Pneumatic Drill Tool, 1442 Beech St., Terre Haute, Ind.
Reilly Tar & Chemical Corp., Merchants Bank Bldg., Indianapolis 4, Ind.
Reliance Electric & Engineering, 24701 Euclid Ave., Cleveland 17, Ohio
Remington Arms Co. Inc., 939 Barnum Ave., Bridgeport 2, Conn.
Remington Rand Div., Sperry Rand Corp., 315 Park Ave., S. New York 10, N. Y.
Reo Div., White Motor Co., 1331 S. Washington St., Lansing 20, Mich.
Republic Rubber Div., Lee Rubber & Tire Corp., Albert St., Youngstown, Ohio
**REPUBLIC STEEL CORP., Republic Bldg., Cleveland 1, Ohio pp168-169**
Research-Cottrell Inc., Bound Brook, N. J.
Revere Copper & Brass Inc., 230 Park Ave., New York 17, N.Y.
Revere Corp. of America, Neptune Meter Co., Wallingford, Conn.
Rexarc Inc., Sight Feed Generator Co., West Alexandria, Ohio
Reynolds Metals Co., Box 2346-ZK, Richmond 18, Va.
Rhoads, J. E., & Son, 2100 W. 11 St., Wilmington 99, Del.
**RIBLET TRAMWAY CO., 1231 N. Washington St., Spokane, Wash. p402**
Rice Pump & Machine Co., Belgium, Wisc.
Ridge Equipment Co., Fallentimber, Pa.
Ridge Tool Co., 400 Clark St., Elyria, Ohio
Richardson Scale Co., Clifton, N. J.
Robbins & Myers Inc., 1345 Lagonda Ave., Springfield, Ohio
Robbins Machine & Mfg Co., Oneonta, Ala.
Roberts & Schaefer Co. Div., Thompson-Starrett Co. Inc., 201 N. Wells St., Chicago 6, Ill.
Robinson Pneumatic Conveyor Systems, 80 Fifth Ave., New York 11, N. Y.
Robinson Clay Product Co., 65 W. State St., Akron 9, Ohio
Robinson Ventilating Co., 276 Henderson St., Zelienople, Pa.
Rockbestos Wire & Cable Co., Cerro de Pasco Corp., Nicoll & Canner Sts., New Haven 4, Conn.
Rockiron Co. Ltd., Sudbury, Ontario, Canada
Rockwell Mfg. Co., 400 N. Lexington Ave., Pittsburgh 8, Pa.
Rockwell Spring & Axle Co., Timken-Detroit Axle Div., 100 Clark St., Detroit 32, Mich.
Rockwell, W. S., Co., 200 Eliot St., Fairfield, Conn.
**ROEBLING'S, JOHN A., SONS, DIV. COLORADO FUEL & IRON CORP., 640 S. Bread St., Trenton 2, N. J. pp32, 359**
Rogers Iron Works Co., Joplin, Mo.
Rohm & Haas Co., 222 W. Washington Sq., Philadelphia, Pa.
Rollway Bearing Co. Inc., 541 Seymour St., Syracuse 4, N. Y.
Rome Cable Division of Alcoa, 330 Ridge St., Rome, N. Y.
Roots-Connersville Blower Div., Dresser Industries Inc., 900 W. Mount St., Connersville, Ind.
Rope Master, Keeney, Paul E., Co., 1125 S. E. Grand Ave., Portland 14, Ore.
**ROSS SCREEN & FEEDER CO., 100 Quimby St., Westfield, N. J. p366**
Round & Son Inc., Box 9557, Cleveland 39, Ohio
Ruberoid Co., 500 Fifth Ave., New York 36, N. Y.
Russell Mfg., Middletown, Conn.
Ryerson & Son Inc., Box 8000A, Chicago 80, Ill.
Safety Clothing & Equipment Co., 1995 E. 69 St., Cleveland 3, Ohio

# S

Safety First Supply Co., 425 Magee St., Pittsburgh 19, Pa.
Saginaw Bearing Co., 821 S. Water St., Saginaw, Mich.
Salem Tool Co., Salem, Ohio
Sandvik Steel Inc., Fair Lawn, N. J.
Sandvik Steel Inc., Steel Belt Conveyor Dept., Fair Lawn, N. J.
Sanford-Day Iron Works Inc., Dale Ave., Box 1511, Knoxville 9, Tenn.
Santa Fe Tank Div., Fluor Products Co., Box 1267, Santa Rosa, Calif.
**SAUERMAN BROS. INC., 626 S. 28 Ave., Bellwood, Ill. p328**
Schaffer Poidometer Co., 2828 Saliman St., Pittsburgh 22, Pa.
Schield Bantam Co., 221 Park St., Waverly, Iowa
Schramm Inc., 870 E. Virginia Ave., West Chester, Pa.
Scott Aviation Corp., Lancaster, N. Y.
Scott Williams Mineral Co. Inc., 440 N. Scottsdale Rd., Scottsdale, Ariz.
Screen Equipment Co. Inc., Box 46, Buffalo 25, N. Y.
Screw & Bolt Corp. of America, Box 1708, Pittsburgh 30, Pa.
**SEIBERLING RUBBER CO., Akron 9, Ohio p393**
Seismograph Service Corp., Box 1590, Tulsa 1, Okla.
Shaft & Development Machines Inc., 808 Newhouse Bldg., Salt Lake City 11, Utah
Sharples Corp., 2300 Westmoreland St., Philadelphia 40, Pa.
Sheffield Div., Armco Steel Corp., Sheffield Station, Kansas City 25, Mo.
Shell Oil Co., 50 W. 50 St., New York 20, N. Y.
Shepard Niles Crane & Hoist Corp., Schuyler Ave., Montour Falls, N. Y.
Sheppard, R. H., & Co. Inc., Hanover, Pa.
Sherwin-Williams Co., 101 Prospect Ave. N. W., Cleveland 1, Ohio
Sika Chemical Corp., 35 Gregory Ave., Passaic, N. J.
Silver Engineering Works Inc., 3309 Blake St., Denver 5, Colo.
**SIMPLEX WIRE & CABLE CO., 79 Sidney St., Cambridge 30, Mass. p177**
Simmons Boiler & Machine Co., 9011 Central Ave., Detroit 4, Mich.
Simplicity Engineering Co., Durand, Mich.
Singmaster & Breyer Inc., 420 Lexington Ave., New York 17, N. Y.
SKF Industries Inc., Box 6731, Philadelphia 32, Pa.
Sly, W. W., Mfg. Co., Box 5939, Cleveland 1, Ohio
**SMIT, ANTON & CO., 111 Eighth Ave., New York 11, N. Y. p404**
**SMIT, J. K., & SONS INC., Murray Hill, N. J. p342**
**SMIDTH, F. L., & CO., Rockefeller Center, 1270 Ave. of the Americas, New York 20, N. Y. p361**
Smith-Emery Co., 781 E. Washington Blvd., Los Angeles 21, Calif.
Smith Engineering Works, 502 E. Capital Dr., Milwaukee 12, Wisc.
Smith Tool Co., Box 431, Compton, Calif.
Smith Welding Equipment Corp., 2633 S. E. 4 St., Minneapolis 14, Minn.
Snap-on-Tools Corp., 8026 28 Ave., Kenosha, Wisc.
Solar Aircraft Co., 2200 Pacific Highway, San Diego 12, Calif.
Sorel Steel Foundries Ltd., Room 504, 1405 Peel St., Marine Bldg., Montreal 2, P. Q., Canada
South Bend Lathe Inc., 425 E. Madison St., South Bend 22, Ind.
Southwestern Engineering Co., 4800 Santa Fe Ave., Los Angeles 58, Calif.
Southwestern Industrial Electronics Co., Box 22187, Houston 27, Texas
Spang & Co., 143 Etna St., Butler, Pa.
Special Instruments Laboratory Inc., 312 W. Vine Ave., Knoxville, Tenn.
Spectrochemical Laboratories Inc., 8350 Frankstown Ave., Pittsburgh 21, Pa.
Spencer Chemical Co., Dwight Bldg., Kansas City 5, Mo.
**SPRAGUE & HENWOOD INC., 221 W. Olive St., Scranton, Pa. p331**
**SPRAYING SYSTEMS CO., 3201 Randolph St., Bellwood, Ill. p415**
Sprenghether, W. F., Instrument Co. Inc., 4567 Swan Ave., St. Louis 10, Mo.
Stackpole Carbon Co., St. Marys, Pa.
Stahl Gear & Machine Co., 3901 Hamilton Ave., Cleveland 14, Ohio
Stanco Mfg. Corp., 1666 Ninth St., Santa Monica, Calif.
Standard Metal Mfg. Co., Malinta, Ohio
**STANDARD OIL CO. OF CALIFORNIA, WESTERN OPERATIONS INC., 225 Bush St., San Francisco 20, Calif. p5**
**STANDARD STEEL CORP., 5060 Boyle Ave., Los Angeles 58, Calif. p388**
Star Hydraulics Inc., 420 Lexington Ave., New York 17, N. Y.
Star Wire Screen & Iron Works Inc., 2515 San Fernando Rd., Los Angeles 65, Calif.
Sta-Vis Oil Co., 2314 Wycliff St., St. Paul 14, Minn.
Stearns Magnetic Products, 635 S. 28 St., Milwaukee 46, Wisc.
**STEARNS ROGER MFG. CO., 660 Bannock St., Box 5888, Denver 17, Colo. p307**
Stein, Hall & Co. Inc., 285 Madison Ave., New York 17, N. Y.
Stephens-Adamson Mfg. Co., 260 Ridgeway Ave., Aurora, Ill.

Sterling Electric Motors Inc., 5401 Telegraph Rd., Los Angeles 22, Calif.
**STEWART-WARNER CORP., ALEMITE DIV., 1826 Diversey Parkway, Chicago 14, Ill. p178**
Stockham Valves & Fittings, Box 2592, Birmingham, Ala.
Stone & Webster Engineering Corp., 90 Broad St., New York 4, N. Y.
**STOODY CO, Box 901, Whittier, Calif. p352**
Stop-Fire Inc., U. S. Highway 1 at Blackhorse Lane, New Brunswick, N. J.
Stratex Instrument Co., 3515 Sunset Blvd., Los Angeles 26, Calif.
Stratoflex Inc., Box 10398, Fort Worth, Tex.
**STRAUBE MFG. CO., 8381 Baldwin St., Oakland 21, Calif. p410**
Streeter-Amet Co., Grayslake, Ill.
Stroh Process Steel Co., Calif. & Marvista Aves., Pittsburgh 12, Pa.
**STURTEVANT MILL CO., 101 Clayton St., Boston 22, Mass. p402**
Sumo Pumps Inc., 23 Brown House Rd., Stamford, Conn.
Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.
Superior - Lidgerwood - Mundy Corp., 1101 John Ave., Superior, Wisc.
Surface Combustion Div., Midland-Ross Corp., 2375 Dorr St., Toledo 1, Ohio
Sutoblit Corp., Fuller Co., 2966 E. Victoria St., Compton, Calif.
Sutton Steele & Steele Inc., 1031 S. Haskell St., Dallas 23, Tex.
Sylvania Electric Products Inc., Chemical & Metallurgical Div., Towanda, Pa.
Synthane Corp., River Rd., Oaks, Pa.

# T

Talk-A-Phone Co., 5013 N. Kedzie Ave., Chicago 25, Ill.
Tamping Bag Co. Div., Pickard Industries Inc., 218-24 S. Third St., Mt. Vernon, Ill.
Taylor Fibre Co., Norristown, Pa.
Taylor Wharton Div., Harsco Corp., High Bridge, N. J.
Templeton, Kenly & Co., 16 & Gardner Rd., Broadview, Ill.
Tennessee Corp., Grant Bldg., Atlanta, Ga.
**TEXACO INC., 135 E. 42 St., New York 17, N. Y. p33**
Texas Gulf Sulphur Co. 75 East 45 St., New York, N. Y.
Texas Instruments Inc., Geosciences & Instrumentation Div., 3609 Buffalo Speedway, Houston, Tex.
Thayer Scale, Pembroke, Mass.
Thermoid Div., H. K. Porter Co. Inc., Whitehead Rd., Trenton 6, N. J.
Thew Shovel Co., Lorain, Ohio
Thomas & Betts Co., 36 Butler St., Elizabeth 1, N. J.
Thomas Foundries Inc., Box 1111, Birmingham 1, Ala.
Thompson Products Ltd., St. Catharines, Ontario, Canada
Thompson, Ramo - Wooldridge Inc., Valve Div., 1455 E. 185 St., Cleveland 10, Ohio
**THOR POWER TOOL CO., Aurora, Ill.**
Thurman Scale Co., 1939 Refugee Rd., Columbus, Ohio
Tidewater Oil Co., 660 Madison Ave., New York 21, N. Y.
**TIMKEN ROLLER BEARING CO., 1835 Dueber Ave., Canton, Ohio pp182, 4 cov.**
Toledo Scale Div., Toledo Scale Corp., 1112 Telegraph Rd., Toledo 12, Ohio
Tool Steel Gear & Pinion Co., 211 Township Ave., Cincinnati 16, Ohio
Torrington Co., 59 Field St., Torrington, Conn.
Torsion Balance Co., Clifton, N. J.
Trabon Engineering Co., 28815 Aurora Rd., Solon, Ohio
Trans-Weigh Corp., King of Prussia, Pa.
**TRAYLOR ENGRG. & MFG. CO., Allentown, Pa. pp17, 18-19, 20**
**TREADWELL, M. H., CO. INC., 140 Cedar St., New York 6, N. Y. p163**
Trico Fuse Mfg. Co., 2948 N. 5th St., Milwaukee 12, Wisc.
Trojan Powder Co., 17 E. 7th St., Allentown, Pa.
Tube Turns Div., Chemetron Corp., 224 E. Broadway, Louisville, Ky.
Tweco Products Inc., Boston at Mosley, Wichita 1, Kan.
Twin Disc Clutch Co., Racine, Wisc.
**TYLER, W. S., CO., 3615 Superior Ave., Cleveland 14, Ohio p381**

# U

Ultra-Violet Products Inc., 5114 Walnut Grove Ave., San Gabriel, Calif.
Union Chain & Mfg. Co., Sandusky, Ohio
Union Switch & Signal Div., Westinghouse Air Brake Co., Swissvale, Pa.
Union Wire Rope Corp., Armco Steel Corp., 2100 Manchester Ave., Kansas City 26, Mo.
Unit Crane & Shovel Corp., 6411 W. Burnham St., Milwaukee 19, Wisc.
U. S. Electrical Motors Inc., 200 E. Slauson Ave., Los Angeles 54, Calif.
**U. S. FOUNDRIES INC., 1135 Quivas St., Denver 4, Colo. p408**
U. S. Gauge Div., American Machine & Metals, Sellersville, Pa.
U. S. Hoffman Machinery Corp., Air Appliance Div., 103 4th Ave., New York 3, N. Y.
U. S. Pipe & Foundry Co., 3300 N. First Ave., Birmingham 2, Ala.
**U. S. RUBBER CO., MECHANICAL GOODS DIV., 1230 Ave. of the Americas, New York 20, N. Y. pp56-57**
**U. S. RUBBER CO., 1230 Ave. of the Americas, New York 20, N. Y. p320**
**U. S. STEEL CORP., 525 Wm. Penn Place, Pittsburgh 30, Pa. p335**
**U. S. STEEL CORP., COLUMBIA-GENEVA STEEL DIV., 120 Montgomery St., San Francisco 6, Calif.**
**U. S. STEEL CORP., NATIONAL TUBE DIV., 525 Wm. Penn Place, Pittsburgh 30, Pa.**
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Universal Dredge Mfg. Co., 124 Wazee Market, Denver 4, Colo.
Universal Engineering Corp., 625 C Ave. N. W. Cedar Rapids, Iowa
Universal Motor Co., 422 Universal Dr., Oshkosh, Wisc.
Universal Road Machinery Co., Emerick St., Kingston, N. Y.
Universal Vibrating Screen Co., Deane Blvd. & St. Paul RR, Racine, Wisc.
**UTAH HYDRO CORP., 150 E. 7 S., Salt Lake City, Utah p432**

# V

**VAN GORP MFG. INC., Box 123, Pella, Iowa p404**
Vapor Recovery Systems Co., 2820 N. Alameda St., Compton, Calif.
Varel Mfg. Co., Box 13146, Dallas, Texas
**VARIAN ASSOCIATES, 611 Hansen Way, Palo Alto, Calif. p144**
Vascoloy-Ramet Corp., 800 Market St., Waukegan, Ill.,
Viber Co., 726 S. Flower, Burbank, Calif.
Vickers Inc., Administrative & Engineering Center, Detroit 32, Mich.
Vickers Inc., Electric Products Div., St. Louis 3, Mo.
Vickers Inc., Tulsa Products Div., Tulsa, Okla.
**VICTAULIC CO. OF AMERICA, Box 509, Elizabeth, N. J. p362**
**VICTOR EQUIPMENT CO., ALLOY ROD & METAL DIV., 13808 E. Imperial Highway, Norwalk, Calif. p397**
Vogt, Henry, Machine Co., 1000 W. Ormsby, Louisville 10, Ky.
Vulcan-Cincinnati Inc., 120 Sycamore St., Cincinnati 2, Ohio
**VULCAN IRON WORKS CO., 2960 S. Fox, Englewood, Colo. pp348-349**

# W

Wadsworth Electric Mfg. Co., 20 W. 11 St., Covington, Ky.
Wagner Electric Corp., 6401 Plymouth Ave., St. Louis 33, Mo.
Wah Chang Corp., 233 Broadway, New York 7, N. Y.
Walker Brothers, Spring Mill Rd., Conshohocken, Pa.
Wallace & Tiernan Inc., Belleville 9, N. J.
Walsh Refractories Corp., 101 Ferry St., St. Louis 7, Mo.
Walter Motor Truck Co., School Road, Voorheesville, N. Y.
Walvoord, O. W., Inc., 301 Detroit St., Denver 6, Colo.
Walworth Co., 750 Third Ave., New York 17, N. Y.
**WARN MFG. CO., Box 6084, Riverton Branch, Seattle 88, Wash. p412**
Warren-Knight Co., 136 N. 12 St., Philadelphia 7, Pa.
Warren Pumps Inc., 606 Bridges Ave., Warren, Mass.
Washington Iron Works, 1500 6 Ave. S. Seattle 4, Wash.
Watt Car & Wheel Co., Barnesville, Ohio
Waukesha Motor Co., Waukesha, Wisc.
Weatherhead Co., Fort Wayne Div., 128 W. Washington Blvd., Fort Wayne, Ind.
Webb, Jervis B., Co., 8951 Alpine Ave., Detroit 4, Mich.
**WEDGE WIRE CORP., Gass St. & N. P. R. R., Wellington, Ohio p388**
Wellington Sears Co., 111 W. 40 St., New York 18, N. Y.
Welsh Mfg. Co., 9 Magnolia St., Providence 9, R. I.
**WESTERN CONVEYOR CO., Box 357, Boise, Idaho p354**
**WESTERN MACHINERY CO., WEMCO DIV., 650 Fifth St., San Francisco 7, Calif. p84**
**WESTERN PRECIPITATION DIV., JOY MFG. CO., 1000 W. 9 St., Los Angeles 15, Calif. p409**
**WESTERN ROCK BIT MFG. CO., 552 W. 7 St., Salt Lake City 4, Utah p358**
**WESTINGHOUSE ELECTRIC CRORP., Box 2278, Pittsburgh 30, Pa. pp38-39, 382-383**
**WESTINGHOUSE ELECTRIC CORP., STURTEVANT DIV., Hyde Park, Boston 36, Mass.**
West Virginia Belt Repairs Inc., Box 32, Mt. Hope, W. Va.
West Virginia Works, Connors Steel Div., H. K. Porter Co. Inc., Box 118, Huntington 6, W. Va.
**WESTERN GEAR CORP., INDUSTRIAL PDTS. DIV., Box 126, Belmont, Calif. p403**
Western Insulated Wire Co., 2425 E. 30 St., Los Angeles, Calif.
Westfall Equipment Co., 437 N. Columbia Blvd., Portland 17, Ore.

Westinghouse Air Brake Co., Ind. Products Div., Wilmerding, Pa.
**WHEEL TRUEING TOOL CO., 3200 W. Davison Ave., Detroit 38, Mich. 3rd cover**
Wheelabrator Corp., 1202 S. Byrkit St., Mishawaka, Ind.
Wheeler, C. H., Mfg. Co., Lehigh & Sedgley Aves., Philadelphia 32, Pa.
Wheeling Steel Corp., 1134-1140 Market St., Wheeling, W. Va.
White, David, Instruments Realist Inc., N93 W 16288 Megal Dr., Menomonee Falls, Wisc.
Whiting Corp., 157 & Lathrop, Harvey, Ill.
**WICKWIRE SPENCER STEEL DIV., COLORADO FUEL & IRON CORP., 575 Madison Ave., New York 22, N. Y. p340-341**
**WILD HEERBRUGG INSTRUMENTS, INC., Main & Covert Sts., Port Washington, N. Y. p321**
**WILFLEY, A. R., & SONS, Denham Bldg., Box 2330, Denver 2, Colo. p90**
Wilkerson Corp., 1604 W. Girard Ave., Englewood, Colo.
Willson Products Div., Ray-O-Vac Co., 200 Thorn St., Reading, Pa.
Wilson Rubber Co., Becton, Dickinson & Co., 1200 Garfield Ave., S. W. Canton 6, Ohio
Wincharger Corp., Sioux City 2, Iowa
Winston Bros. Co., 301 Clifton Ave., Minneapolis 3, Minn.
Wire Rope Corp. of America Inc., 609 N. 2 St., St. Joseph, Mo.
Wisconsin Motor Corp., Milwaukee 46, Wisc.
Whitmore Mfg. Co., Box 1640 Station C., Cleveland 4, Ohio
Winter Weiss Co., 2201 Blake St., Denver 5, Colo.
Wintroath Pumps Div., Worthington Corp., 1100 S. Meridian Ave., Alhambra, Calif.
Witte Engine Works, Oil Well Supply Div., U. S. Steel Corp., 1600 Oakland Ave., Kansas City 26, Mo.
Alan Wood Steel Co., Conshohocken, Pa.
Worklon Inc., 253 W. 28 St., New York 1, N. Y.
Wright Power Saw & Tool Corp., Thomas Industries, 1419 Illinois Ave., Sheboygan, Wisc.
Wyandotte Chemicals Corp., Michigan Alkali Div., Wyandotte, Mich.

# Y

Yale & Towne Mfg. Co., Yale Materials Handling Div., 11,000 Roosevelt Blvd., Philadelphia 15, Pa.
Yarnall-Waring Co., 102 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, Pa.
Yaun Mfg. Co. Inc., 2120 N. Third St., Box 1508, Baton Rouge, La.
Youngstown Sheet & Tube Co., Box 900, Youngstown 1, Ohio

## The Classified Advertising in

# E&MJ's Searchlight Section

***on pages 416-419 is an excellent guide to sources of USED EQUIPMENT and other special services.***

## Professional Services,

***including CONSULTANTS, are advertised after page 420. The experts listed can solve many of your problems.***

# PART 3.

**Advertiser's District Sales Offices. See page 421**

# NEW from Cummins!
# Only from Cummins!

*The first V diesels of their size and h.p. built from the pan up for constr*

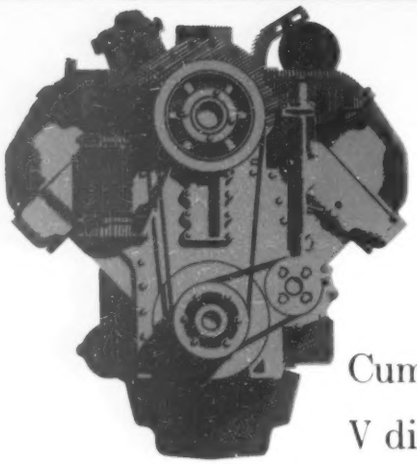
V T

V

T 8.430 h.p.

*nstruction machines!*

/ 8.350 h.p.



# V8-430

# VT8-430

Cummins has done it again! Built two V diesels in the much needed 350-430 horsepower class especially for construction machines. This opens a new world of *Cummins Diesel economy* for big scrapers, off-highway trucks, shovels, front end loaders and other equipment where there has been a demand for compact yet large bore, big displacement engines.

The 350 h.p. and the 430 h.p. V8 engines are construction diesels from front to back, top to bottom. Every kind of application—every operating condition was considered in their design. The V8's represent the *most advanced* thinking in construction power on the market today! New features, major improvements combined with Cummins proven basic design makes them the most profitable source of power you can own or operate! And here's why...

CUMMINS

THE DIESEL TH
ANCE OF ENGIN

430 horsepower! 990
displacement! 7 lbs.
Put these facts to
Cummins VT8-430 T
that's as much as 4
engines in current us

From its very co
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turbocharging pack
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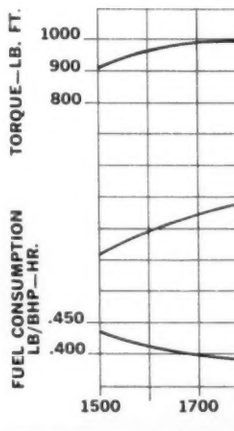
All in all, the V
high performance, l
operating life as well
larger engines in it
kind of economy!

VT8




Curves represent performan

**CUMMINS ENGINE COMPANY, INC., COLUMBUS, INDIANA**

INTERNATIONAL SALES & SERVICE — CUMMINS DIESEL INTERNATIONAL LTD., NASSAU, BAHAMAS — CABLE: CUMNAS
OVERSEAS FACTORY — CUMMINS ENGINE COMPANY LTD. — SHOTTS, LANARKSHIRE, SCOTLAND

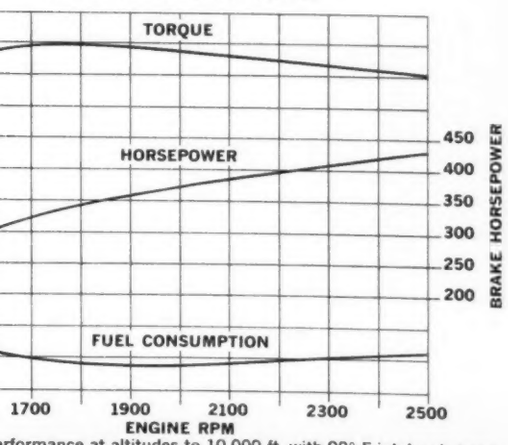
Litho in U.S.A. — MP-60

L THAT DELIVERS THE PERFORM-
NGINES WITH *4 MORE CYLINDERS!*

er! 990 ft. lbs. peak torque! 950 cubic inch
7 lbs. per h.p.! Less than 59 inches long!
cts together and you have the rugged
8-430 TURBODIESEL® Engine—the diesel
h as 40% smaller and more compact than
rent use delivering equal power.
very concept, the VT8-430 was designed to
benefits of turbocharging. Not only does
pack more power into the engine, but it
ted horsepower up to 10,000 feet. Cummins
developed a lightweight, perfectly-balanced
that gives fast acceleration—trouble-free
Further, the VT8 operates at low exhaust
assuring long life for both the engine and

puts the accessories on top of the block, in
d by the cylinder banks. This means greater
easier maintenance, less costly repairs. In-
nsert-type injectors are much easier to install
Vet-type liners require less time to remove,
install. These are only few of the many
this new Cummins Construction Diesel.
the VT8-430 gives you a combination of
nce, low fuel costs (see chart below), long
as well as a lower initial investment than the
in its power class. You can't beat this
my!

VT8-430 PERFORMANCE CURVES




erformance at altitudes to 10,000 ft. with 90° F intake air temp.

# V8-350

NEVER BEFORE, SO MUCH POWER FROM SUCH A COMPACT, NATURALLY-ASPIRATED DIESEL!

Here's rugged construction power! 805 ft. lbs. peak torque —*naturally!* (See curves below.) Like the VT8, this engine has a piston displacement of 950 cubic inches and rotates at 2500 rpm. This produces 350 horsepower in a package that's less than 57 inches long.

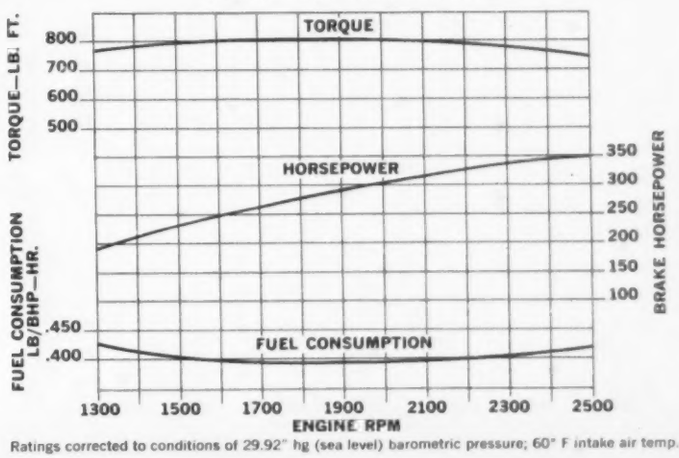
The V8-350 has many new features to reduce operating costs. New internal fuel and oil lines eliminate threaded connections, damage to exposed lines. Cummins own 12 cfm air compressor is supplied on both engines. Of simple, one cylinder design, here is the only unit in the trade backed by a 3600 hour or one year warranty.

Another practical advantage of the V8 Diesels is the 2500 rpm. This gives you an ideal relationship of horsepower, torque and speed to permit the use of lighter, more compact, less costly transmissions. In other words, your initial investment is reduced as well as the maintenance cost during operating life.

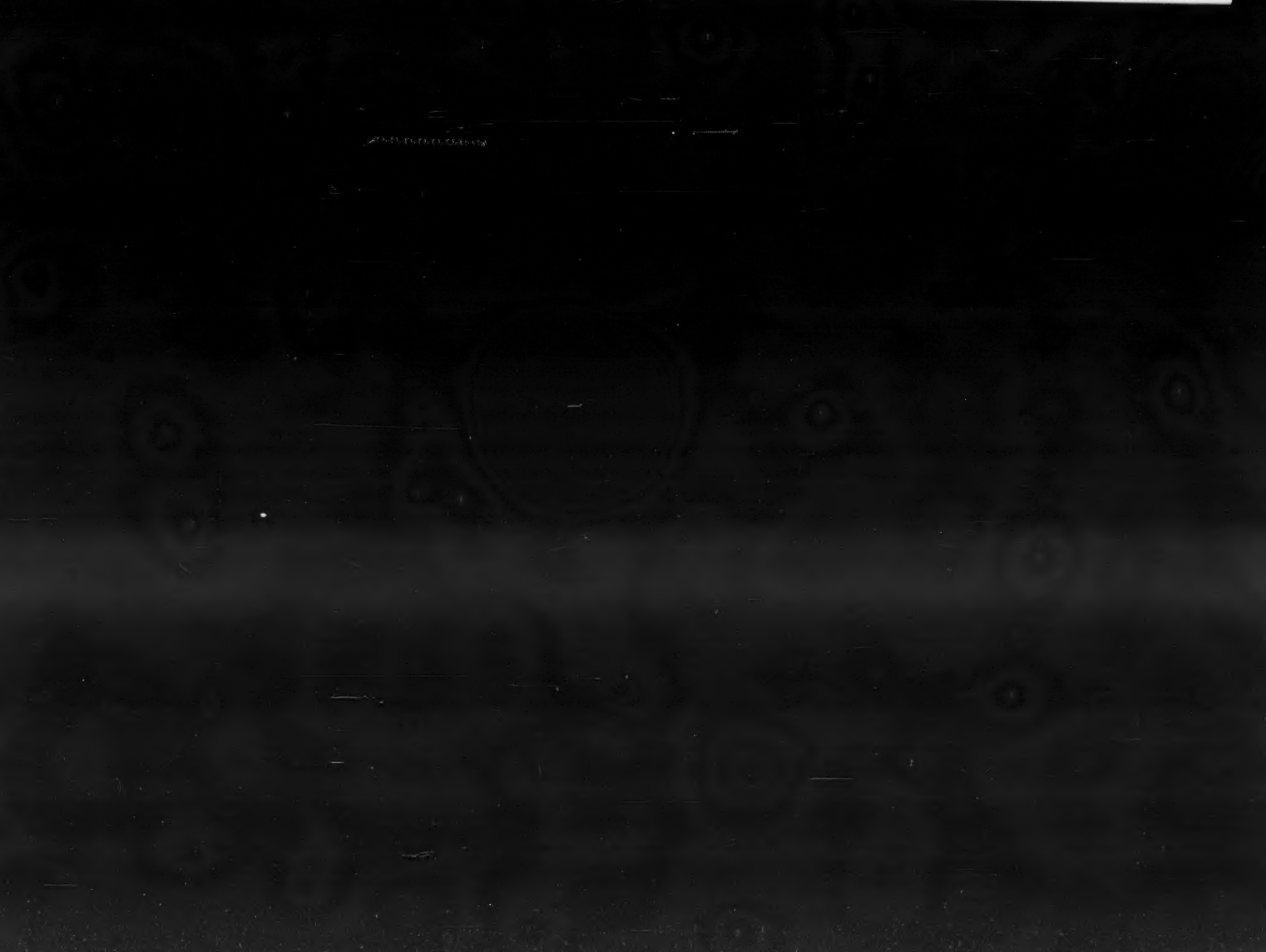
Cummins exclusive PT fuel system also reduces maintenance and fuel costs. It operates on lower priced No. 2 diesel fuel . . . has fewer parts than any other diesel fuel system. The pump is mounted in the 90° angle formed by the cylinder banks. Also possible, on the V8-350 . . . either the intake or exhaust manifold can be placed inside the "V" to fit your application requirements.

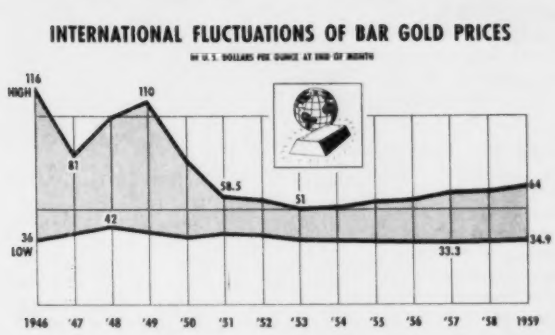
Get the complete profit-making story on these new compact V diesels, and on the models in which they are available, from your nearest construction equipment representative or Cummins Distributor.

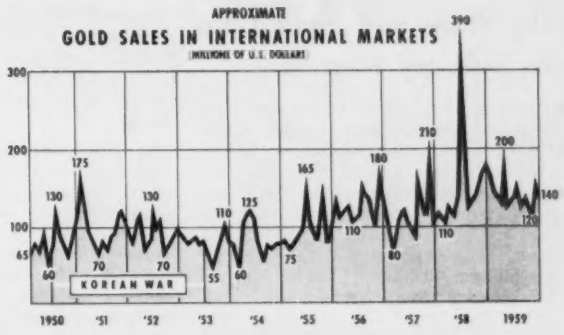
V8-350 PERFORMANCE CURVES




Ratings corrected to conditions of 29.92" hg (sea level) barometric pressure; 60° F intake air temp.






# Pick Cites Record World Gold Output

GOLD PRODUCTION in 1959 in the countries of the Free World reached an all-time high of $1.134-billion (estimated) according to Franz Pick, publisher of the 1960 Currency Yearbook. In his latest volume, the publisher of "Pick's World Currency Report," also cited increased gold production behind the Iron and Bamboo Curtains to the tune of $747-million. U.S. production declined to $48.6-million. (See table.)

In his introduction to the gold chapter, Mr. Pick comments on the outflow of U.S. gold and the declining gold position of the U.S. (See this month's Editorial, p 91.)

He also notes that Soviet gold policy, "often belittled by various Western governments and openly questioned by Mr. Khrushchev, remained as conservative as ever in 1959 . . . and underscored . . . the Russian understanding of the power that gold gives to a government which owns the metal free and clear."

Pick places total gold production for the world at $1.881-billion, against $1.774-billion for 1958, and notes the USSR share of the $747-million Communist world was probably $683-million.

In a discussion of gold holdings, official and otherwise, the author offers the following tentative establishment of figures at year-end 1959 (in billions of U. S. dollars):

| | | |
|---|---|---|
| Official gold stocks | | $40.599 |
| Unpublished French holdings | (est) | .200 |
| Soviet gold stock | (est) | 8.700 |
| Satellite gold stock | (est) | .750 |
| Total | | 50.249 |

Of the above total, some $19.5-billion is attributed to the U.S. holdings; $2.750-billion for Britain; $2.637-billion for West Germany; and $2.828-billion among international agencies and monetary administrations.

Hoarding, according to Pick, rose to an all-time high of its own; based, he believes, on "the general doubt concerning the present life expectancy of the U.S. dollar. . . ." France, the major hoarder, reduced its totals last year and Africa was estimated to keep its hoard unchanged, but Asia and Europe outside of France increased its holdings.

London led the world as a market for bar gold and saw more than 50% of the total transactions cleared through its offices. Paris ranked second and Zurich, although third in total volume, led in coin transactions.

### Free World Gold Output

(Millions of U. S. dollars)

| | 1950 | 1958 | 1959 (est.) |
|---|---|---|---|
| Total | $864.5 | $1,049.0 | $1,134.0 |
| of which: | | | |
| Un. of S. Africa | 408.2 | 618.0 | 702.3 |
| Canada | 155.4 | 158.8 | 156.9 |
| U. S. A. | 80.1 | 53.0 | 48.6 |
| All Other Countries | 220.8 | 209.2 | 226.2 |

# American Gilsonite Announces Expansion; New Mining Method

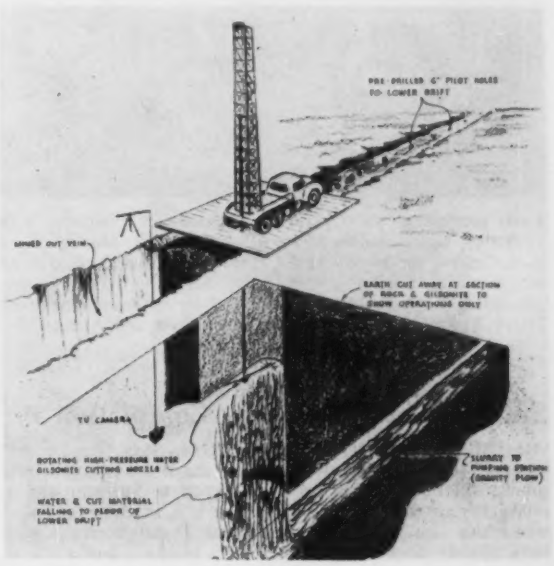
**The refinery plant** of American Gilsonite Co., which converts the unique gilsonite mineral taken from its mines in Bonanza, Utah, at its operation outside of Grand Junction, Colo., has announced an expansion that will "almost double capacity by late spring."

The 72-mile pipeline between mine and plant which carries the ore in a slurry over a mountain pass (E&MJ, September 1957) is to be capable of handling 1,100 tpd instead of the current 650 tpd.

According to Ernest F. Goodner, president of the firm, the increase in pipeline capacity was made possible by "a precise control of the ratio" of solid gilsonite to the suspension water. The increase in pipeline flow involved changes in the system at the pumping station and a 10% speed increase.

A new mining method, wherein fewer personnel will work underground in the gilsonite veins was also outlined by the company. Drills put through the ore from the surface (see illustration) will open 6-in. holes. Water at 2,500 psi will be delivered through the nozzles against the friable ore, which drops to the drift below and is carried to a sump. Pumps below the surface move the ore to the main pumping plant for simple milling and introduction into the 72-mile pipeline.

Another innovation suggested by AGC is the use of a television camera to monitor the subsurface nozzle.


PRE-DRILLED 6" PILOT HOLES TO LOWER DRIFT
MINED OUT VEIN
EARTH CUT AWAY AT SECTION OF RAISE & GILSONITE TO SHOW OPERATIONS ONLY
TV CAMERA
ROTATING HIGH-PRESSURE WATER GILSONITE CUTTING NOZZLE
SLURRY TO PUMPING STATION (GRAVITY FLOW)
WATER & CUT MATERIAL FALLING TO FLOOR OF LOWER DRIFT

## Oil Shale and Sand Gain In Industry Interest

THE DISMANTLING of Union Oil Co.'s research facilities near Grand Valley, Colo., and the announcement by the AEC of a June high-explosive blast test at Rifle, Colo., offered contrasting developments in oil shale mining; while announced plans to mine tar sand in Alberta and a proposal to use nuclear blasting on Alberta's oil sands brings oil sand mining closer to reality.

**Union Oil Co. is dismantling** its oil shale research facilities near Grand Valley, Colo., because "the present depressed price of crude oil and the tax picture are such as to make the process uneconomic at this time," according to senior vice president A. C. Stewart. Union's research plant demonstrated the efficiency of its patented retorting process by extracting as much as 26 gallons of oil from a ton of shale. Stewart also said, "Looking forward to the day when full scale commercial oil shale operations will be carried on, Union expects to maintain both its land and water rights positions."

**Freeing of oil** from Alberta's oil sands region by means of an underground nuclear explosion was proposed by Dr. D. B. Scott, professor of physics at the University of Alberta. Scott based his proposal on studies made by Alberta's technical committee which was set up to analyze the tests. The proposed project would be an undertaking of Richfield Oil Co.

**The AEC will detonate** two chemical high explosive charges beneath the floor of the Bureau of Mines experimental oil shale mine near Rifle, Colo., in June. The purpose of the experiment will be to obtain information useful in predicting the effects of a nuclear detonation in oil shale, a proposal currently under study by Lawrence Radiation Lab, Livermore, Calif., as part of the Plowshare program.

In the June experiment, one high explosive charge of 1,000 lb will be planted at the base of a 115-ft sealed hole; the other, a 5,000-lb charge, will be at the 125-ft depth. A minute amount of krypton-85, an inert radioactive gas, will be placed in the holes as a tracer to detect gas migration resulting from the explosion.

**Great Canadian Oil Sands Ltd.** has arranged to sell synthetic crude oil to Sun Oil Co. and Canadian Oil Companies Ltd. The product will come from Great Canadian's hundred-million-dollar project to mine tar sand in the Mildred-Ruth Lakes area of Alberta. The company will extract and partially refine bitumen from the sand and deliver it by pipe-line to Edmonton. Target date for initial production is fall of 1962 with full production of 11.5-million barrels per year by spring of 1963. (See E&MJ, March 1960, p 108)

## Tri-State, American Zinc Plan 3,600-tpd Mill, Mine

AN INDICATED 1-million-ton high grade zinc orebody near New Market, Tenn., has been turned over by American Zinc, Lead and Smelting Co. to Tri-State Zinc Inc., a subsidiary of Consolidated Goldfields of South Africa through its Gold Fields American Development Co. Ltd.

Tri-State will develop the orebody and sink the necessary shafts "or incline to bring the mine into production at the earliest possible date" according to Robert F. Playter, president, and Howard I. Young, president of American Zinc.

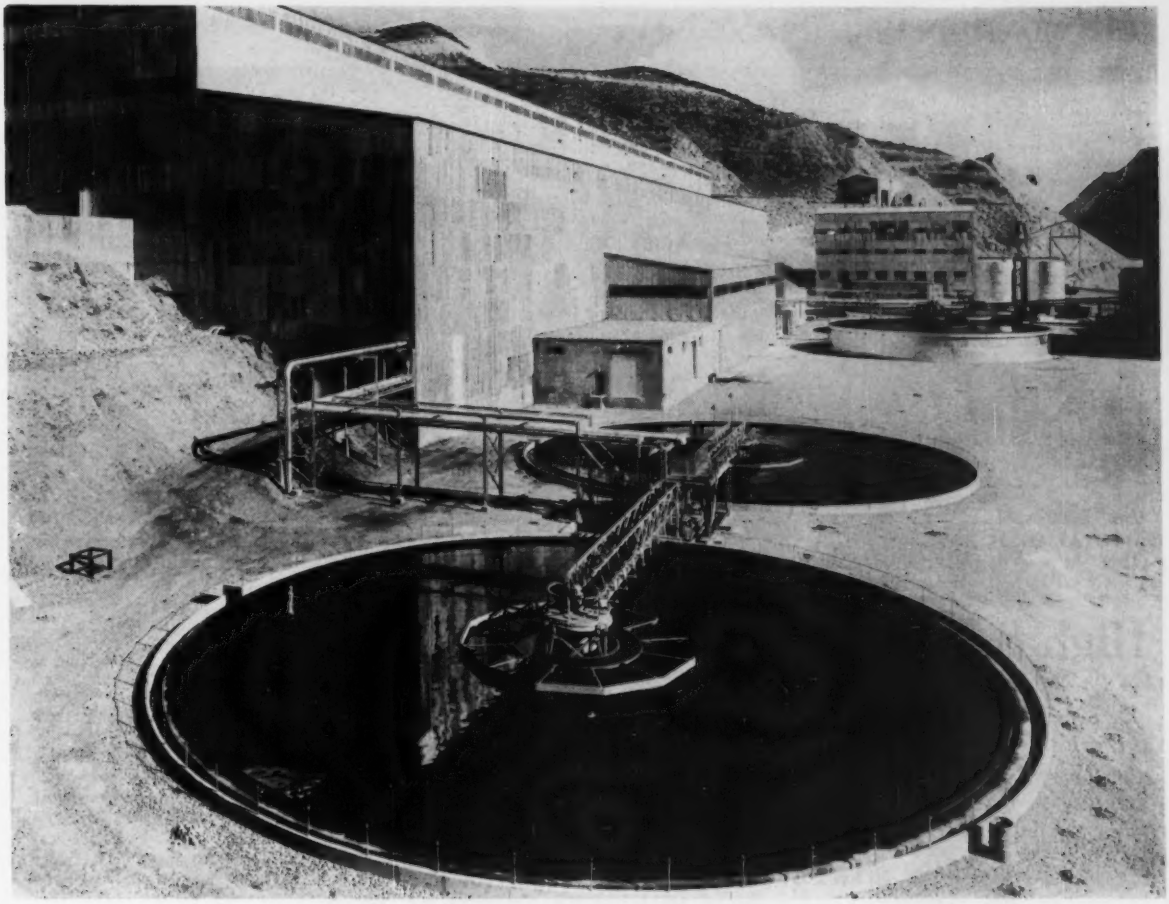
A 3,600-tpd mill will also be built by Tri-State, which will operate on American Zinc ores until its own mine is producing. Concentrates produced will go to American Zinc, Lead and Smelting Co. facilities. Total capital investment by Tri-State is estimated at $3- to $4-million, and annual concentrate production at 35,000 to 40,000 tons. Operating profits will be divided between the two companies.

**Early participants** in "Operations Grasshopper," included Tom O'Malley, vice president of Aero Service; H. R. Massink, Surinam Central Bureau of Aerial Mapping; C van Kooten, director, Surinam Mining & Geological Services; P. Wijngaarde, journalist; W. J. Snijders, deputy director of development; Sir Harry Radhakishun, Member of Parliament; and Arthur Thomae, Aero Service pilot.

## Surinam Survey Nears Completion

AERIAL MAGNETIC MAPS for "Operations Grasshopper" (see pp 104-113) part of Surinam's major development program, will be available for examination in Surinam and at consulates of the Netherlands, in the U.S., Canada and elsewhere this year. Maps for block 1 and 2, shown on the map, have already been delivered. Maps for blocks 3 and 4 will be delivered during July, August and September. Some 264 map sheets in all, drawn to a scale of 1:40,000 with 20-gamma contour intervals, will be completed.

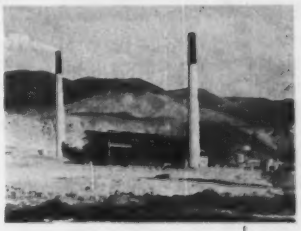
Also shown on the map are 15 airfields in and adjacent to Surinam. Those in the southern part of the country are on savannahs, or in areas cleared in the jungle. They have been planned as jumping-off points for geological exploration and initial mine development. In addition to the fields shown, one is planned near the Brazilian border, and another in the extreme southeastern part of the country.



PROJECT—
COPPER

**Another Complete Mill-to-Smelter Plant ENGINEERED by STEARNS-ROGER**

This smoothly operating project including copper mill, smelter and power plant was designed to process 30,000 tons per day. The engineering performed by Stearns-Roger included designs for concentrator, smelter, heavy density plant, power plant, crushing plant, and specifications for thousands of items of mill and smelter equipment. Engineering of supporting facilities also furnished includes two complete townsites, public buildings, machine and maintenance shops at mine, mill and smelter, transmission lines and lime plant. Stearns-Roger offers reliability in design, engineering, fabrication, field erection and start-up. One-contract engineering services for your chemical or metallurgical plant project are our specialty.



**Stearns-Roger**
THE STEARNS ROGER MFG CO. · DENVER COLORADO
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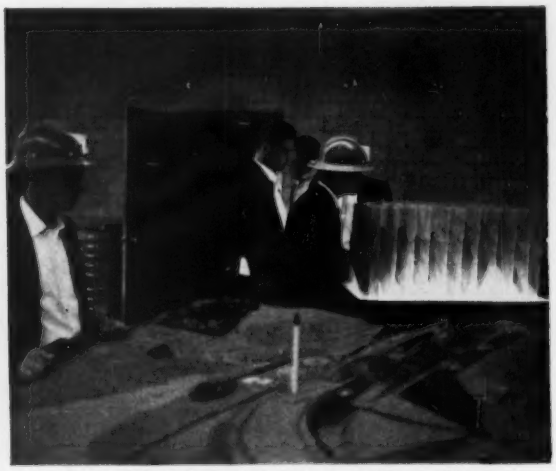
DENVER • HOUSTON • SALT LAKE CITY
Stearns-Roger Engineering Co., Ltd., Calgary, Alberta

**A TOTAL OF 34** students from New York City high schools made the trip in cooperation with AIME, WAAIME and Columbia University.



**GUIDED TOURS** through the Grace Mine at Morgantown, Pa., were conducted by Bethlehem Cornwall Corp., for the visiting group.

# High School Students Tour Grace Mine

**FIRST GIRDER** at the pellet plant of Bethlehem Steel's Grace Mine was placed last month. Full operation from the mine is due in 1962.

ACTIVE dramatization of the appeal of the mining industry was the goal of a group effort by the New York Section of AIME, the organization's women's auxiliary and the Henry Krumb School of Mines of Columbia University last month.

The group, sensitive to the concern expressed at the February annual meeting of AIME's education committee, sought to improve the knowledge of high school students of the mining industry.

Thirty-four students from 12 schools in the metropolitan area were selected by the Columbia group, who proposed the idea, and arrangements were made through the N.Y. Section and the auxiliary. The local section financed the visit. Bethlehem Cornwall cordially extended the invitation to the visitors, provided guides and served lunch.

The students were selected on the basis of a high aptitude in basic mathematics and science, plus a demonstrated interest in the minerals industry.

Introductory lectures by mine personnel preceded the tour of the underground workings and the plant. Reaction by the students was enthusiastic, with some expressing a definite interest in mining as a career.

## African Aluminum

*(Continued from p 23)*

a plant hinges on harnessing the Konkoure's power.

A dam, hydroelectric plant and aluminum smelter project on the Volta River in Ghana. Estimated bauxite reserves in that country total over 200-million tons. Kaiser Industries has made studies of the project for the Ghanan government, and is leading a consortium of North American aluminum companies toward developing it.

A dam and hydroelectric plant to harness the Kouilou River, in the Republic of the Congo, capable of delivering 820,000 kw; Kaiser, Olin Mathieson and five others are studying its possibilities.

A hydroelectric project at Inga Rapids on the Congo River, Belgian Congo, with proposed development of 1.5-million kw by 1965. The site has the potential to yield 25-million kw, an enormous figure (equivalent roughly to one-fifth the entire U.S. hydro-power capacity). The Belgian government is pushing the project. A substantial bauxite orebody has been reported in the lower Congo region. Nine aluminum companies from France, Britain, Canada and the U.S. have formed the Aluminga Syndicate to examine the possibility of an aluminum complex from the Inga power plant.

There are large bauxite deposits near Boke, Guinea, with reserves estimated at over 1-billion metric tons. Aluminium Limited's French mining subsidiary, Bauxites du Midi, holds exclusive exploration rights and mining concessions there. A group of five North American companies may acquire the rights from Bauxites du Midi, according to a plan reportedly under consideration.

A large bauxite deposit which lies in north central Cameroon, between Tibati and Ngaoundere, was discovered in late 1958. The Bureau of Mines of Overseas France has tested it, and reports its size as about 500-million tons. If the route of the proposed Douala-Chad railroad could be changed to pass through the area, the deposit, which is now isolated from both water and rail transportation, would become accessible.

Two deposits in western Cameroon have been discovered, near Fongo-Tongo and near Bangam. Between them they reportedly have reserves of 85-million tons. Authorities regard 100-million tons as the minimum necessary for commercial exploitation. The Bangam deposit may be larger than the initial tests indicated, however.

Guinea was formerly known as French Guinea; Ghana was known as Gold Coast; the Congo Republic was formerly called Middle Congo.

## Bids for Nuclear Blast Shaft Opened by AEC

EXCAVATION of a 12-ft 8-in. dia shaft and the driving of an 8x12 ft drift 1,170 ft back into a potash salt bed on the 1,216 level was bid upon last month

*(Continued on p 321)*

# 5 reasons why Atlas Copco's "TIGER" is best for stoping and all short-hole drilling!

*(1) It's fast and easy to handle!*

*(2) It's easy collaring, with little recoil!*

*(3) Features a retractable air leg!*

*(4) Convenient controls, automatic back head!*

*(5) Operates on single air supply!*

Here's the TIGER—a new, fast, compact rock drill with power and stamina to meet toughest drilling requirements! Its high percussion rate not only speeds penetration, but at the same time cuts recoil to a minimum. With controls conveniently located, collaring is unusually easy.

What's more, the automatic back head prevents dry collaring. Flushing water actually flows before drilling starts. And, the Tiger's "constant blowing" provision sends air through the machine the instant pressure is turned on, keeping water and cuttings from the rotation chuck.

There's still another "plus"—the Tiger's exclusive integral type pusher leg, with retractable piston rod. Operates on a single air supply!

This isn't the whole story by any means. For more facts about the amazing new Tiger rock drill and how it can speed *your* drilling, call your nearest Atlas Copco representative. Or, write to us at Dept. EMJ-10.

**Atlas Copco**

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

# Specify SANDVIK COROMANT ROPE-THREAD bits and steels

## ...for quick hand uncoupling!

No, it's not child's play, but the fact is you can uncouple Sandvik Coromant Rope-Thread bits and steels by hand! Smooth, shallow-depth, rounded threads with a pitch of just 2 turns per inch prevent binding. You'll have fewer thread failures too, compared with "saw-tooth" thread designs. What's more, only the threads are hardened, so you can re-thread steel sections without heat-treating. And, with faster uncoupling, you'll drill more feet per shift!

Coromant bits and steels have many other advantages, too: Better quality carbide (Sandvik is one of the largest manufacturers of carbide in the world)... better, more rigid steel...superior workmanship... all add up to above-average bit and rod life, up to double the footage between sharpenings, and straighter, cleaner holes.

Want proof? Easy! Call us and we'll arrange for a demonstration and test on your job. Write us today. Address: Dept. EMJ-11.

**Atlas Copco**

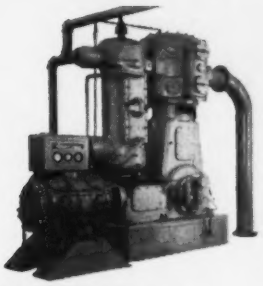
545 Fifth Avenue, New York 17, N.Y.

610 Industrial Avenue
Paramus, New Jersey
COlfax 1-6800

930 Brittan Avenue
San Carlos, California
LYtell 1-0375

# Which... ATLAS COPCO COMPRESSOR

## meets your needs best?



**AR Heavy-Duty Compressors**

More air per horsepower than any comparable compressor! For continuous, full-load operation. "L" angle, 2-stage, double acting. Water cooled. Standard models provide 382 to 3210 cfm free-air delivery at 100 psi; only 76-590 hp required! (Can be supplied for other working pressures on request.)

What's your compressor requirement? Need an installation large enough to provide air for all your needs? Or would a small, compact unit for auxiliary operation solve your immediate problem? Either way—and for a wide range of applications between these extremes—Atlas Copco has the compressor for you!

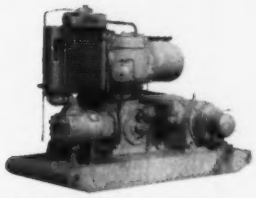
No matter which you choose, you'll get these proven advantages from Atlas Copco:

(1) More air per horsepower—less power consumption than other comparable units!

(2) Really low maintenance (one example — $3.10 after 10,000 hours' operation)!

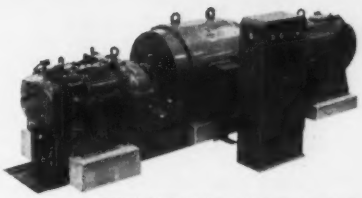
(3) Specifications are guaranteed free-air delivery — you get exactly what you order!

Get all the facts now—and compare! The coupon below will bring you a free catalog. (No obligation, of course.)



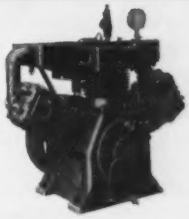
**AR-L Heavy-Duty Compressors**

Same basic construction as the AR Series, but provided with an air-cooled intercooler and air-cooled radiator for the cylinder water. Fan on compressor flywheel cools radiators. Perfect for arid areas or where difficult to bring in water. Both stationary and skid-mounted models available.



**TWIN-AIR Rotary Screw Compressors**

Brand new! "Twin-Air" Compressors offer capacities from 6,900 to 19,400 cfm at working pressures up to 115 psi. And, you get completely *oil-free* delivery of air or gas, since no lubrication is required — timing gears maintain small clearances between precision-mounted rotors, eliminating friction (and the necessity of oil) in compression chamber.



**CT Air-Cooled Compressors**

Stationary, or skid-mounted compressors for use where air demand is between 50 and 300 cfm. Totally air-cooled. Cylinder arrangement designed for smooth, vibration-free operation. Compact, rugged—for continuous, 24-hour trouble-free service. Highly efficient; low on maintenance costs.

**ER-6 Heavy-Duty Compressors**

New! Fundamental improvements over conventional heavy-duty compressors reduce power requirements (18.3 hp/100 cfm at 100 psi, full load); provide totally enclosed design; and save on floor space. Capacities to 1,140 cfm; standard instruments and safety devices.

**ATLAS COPCO**
Dept. EMJ-5, 545 Fifth Avenue,
New York 17, N.Y.

Gentlemen:
Please send me ☐ Short-form catalog ☐ Detailed information on the _____ Series

Name _____ Title _____

Firm _____

Address _____

City _____ Zone _____ State _____

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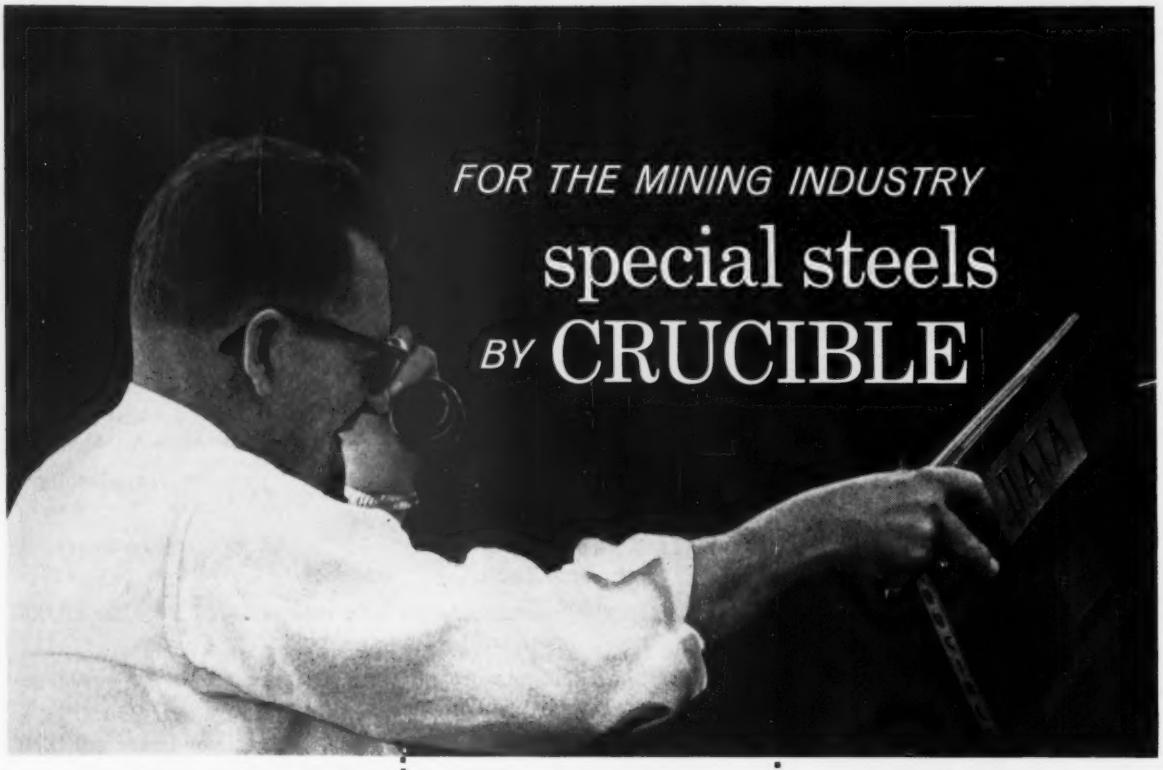



## HOLLOW DRILL STEEL

Crucible drill steel is available for any drilling job—in both carbon and alloy grades—and in a full range of sizes and shapes.

**CARBON:**

**Crusca Hollow Drill Steel** is the popular straight-carbon type — standard throughout the world. It's an easy to work with, all-purpose drill steel for jobs not requiring the tougher alloy grades.

**ALLOY:**

**CA Double Diamond Alloy Hollow** Drill Steel has greater hardness, higher strength than straight-carbon grades. It has superior resistance to fatigue, wear and abrasion.

**4E Alloy Drill Steel** is designed for the really tough jobs. Its resistance to fatigue, and its high-strength, are unmatched.

Crucible produces all these grades to tool steel quality standards. That means fewer broken rods—less valuable bit loss—lower cost per foot of hole drilled.

## MAGNETS

Alnico permanent magnets for magnetos and impulse generators for blasting, miner's lamp safety locks.

## SPRINGS

Heavy hot wound coil springs for crushers, locomotives and cars, vibrating screens, conveying equipment, rock drills, and earth moving equipment.

## TOOL STEELS

All grades, sizes, and types for general tooling, and equipment maintenance.

## ALLOY STEELS

Bars, billets, rods, plate, sheet, strip, wire, and special shapes in all standard AISI grades and many special analyses for . . .

- car axles
- chutes and conveyors
- shaker screens for rock and ore crushers
- coal cutting and loading machinery
- drill bit bodies
- bits and chisels

## STAINLESS STEELS

Heat and corrosion resistant stainless in all grades, types, and mill forms for . . .

- vats and receptacles handling corrosive flotation materials, pump rods
- plates and angles for mancars
- sifting screens

Next time you need hollow drill rods—or *any* type of special purpose steel—the man to call is your local Crucible representative. He can insure immediate deliveries from warehouse stock, or prompt mill shipments. *Crucible Steel Company of America, Pittsburgh 30, Pennsylvania.*

**CRUCIBLE STEEL COMPANY OF AMERICA**

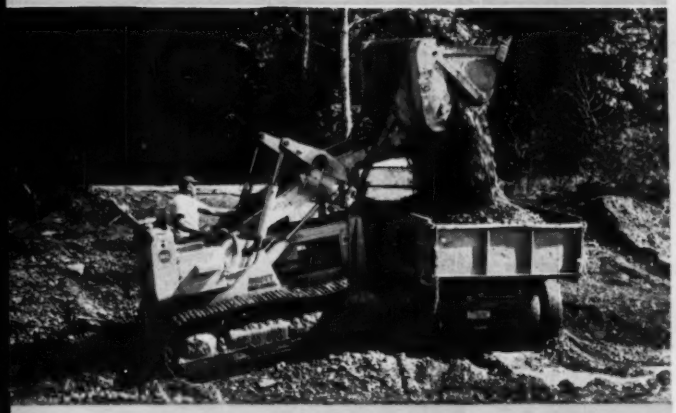
***OWNERS REPORT:***

# How exclusive clam-action 4-in-1 MAKES MONEY where other rigs don't!

## "4-in-1 break-out action saves time and shooting costs"

**—Albert Boehman Coal Mine, St. Meinard, Indiana**

**Albert Boehman Coal Mine uses** an International Drott TD-6 Four-in-One to strip overburden, clean the vein, and load out coal. "I particularly like the 4-in-1's (pry-over-shoe) break-out action which heap-loads the bucket fast, and usually saves 'shooting' costs. The 4-in-1 has the work-producing features of several machines in one." *Here his TD-6 Four-in-One is "digging coal" directly from the vein it uncovered and cleaned.* The 1⅛ cu. yd. TD-6 can apply a tremendous 18,600 lbs. of break-out force!



## "Bottom-dumping 4-in-1 cleans itself out"

**—Marion Young, Bloomington, Indiana**

**"I tried another rig** for a month and had to clean out its bucket with a spade—and that slows you down with 600 to 700 lbs. of dirt stuck in it," states excavating-loading contractor Marion Young. "My bottom-dumping 4-in-1 cleans itself out when I flap the clam (hydraulically)." Here his 4-in-1 is loading wet river-bottom gravel. Exclusive 4-in-1 bottom-dumping eliminates the sticky materials problem!

## "Our 4-in-1 replaces several other rigs"

**—Joseph Borge & Sons, Inc., Swansea, Mass.**

**Joseph Borge & Sons, Inc.,** produce washed sand and gravel from open pits—use their TD-15 Four-in-One to strip overburden, load out, and recontour worked-out pits. Owner reports loading out 1,200-1,800 tons of material per 8 hrs. "Four-in-One versatility and capacity replace several rigs for us," states Vice-president, George Borge. "The clam-action also digs faster and dumps cleaner." Above, their 4-in-1 is "back-dragging" from gravel bank, to speed loading.

**Why limit your income** to what an old-style, single-action loader, or any other limited-duty rig can earn you? See how an International Drott 4-in-1 can give you a whole equipment spread of actions—and each action can double for one or more costly specialized machines. Prove Hydro-Spring performance protection. See your International Drott Distributor for a 4-in-1 demonstration!

International Harvester Company, Chicago 1, Illinois
Drott Manufacturing Corp., Milwaukee 15, Wisconsin

INTERNATIONAL® DROTT®

**Even moving a blade-full** of shot-rock around the curve, there's no hesitation, no sluing to spill the load. The TD-25's operator has separate speed control of each track to get full-capacity performance, full time. And only the new TD-25 has the power plus of the direct-start, turbocharged DT-817 International engine—that delivers 230 high-torque hp!

# HOW POWER-STEERED, POWER-SHIFTED . . . TD-25 takes

## —on California mining operation

**Even before all the blast dust** has settled, this International TD-25 is slamming tons of shot-rock from the benches, so trucks can resume hauling to the processing plant. Then, at this gypsum mine in California, the "25" takes over the "shovel-feeding" chore—dozing full blades of rock upgrade, downgrade, and 'round the curves, to help keep the big dippers swinging full. And in between times, the "25" takes over its third tough project: benching new haul road around mountain slopes!

*Three slam-bang rock operations to handle—it's a made-to-order situation for the Planet Power-steered TD-25!*

**"Dead-track drag" eliminated!** You don't brake a track and "half-kill" your pull-power to turn, as you do with king-sized clutch-steered crawlers. With Planet Power-steering you simply change the speed of one TD-25 track—on-the-go, and with 2-finger ease! Around comes the fully-loaded TD-25—with "live" power on both tracks and both tracks pulling. Load-limiting "dead-track drag" is eliminated!

And combined, on-the-go Hi-Lo power-shifting lets you match power to load, instantly—forward or reverse. Just shift one track to high range—the other to low—to do slope-hugging, full-bite benching, or to operate straight ahead with off-center loads!

The "25" is platformed on new 7-roller tracks with double-box-beam frames. The design provides super undercarriage strength for slam-bang conditions—strength to match the full effort of the direct-start, high-torque DT-817 International Diesel engine.

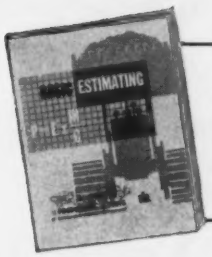
**Power-steer and power-shift the TD-25** with king-sized loads. Measure the bonus capacity you get with exclusive Planet Power-steering and Hi-Lo power-shifting. See how this control combination enables you to outearn other big rigs up to 50%. Then measure what it means to get this double-barreled advantage *only* in the TD-25—and as standard equipment *to boot!* Let your International Construction Equipment Distributor demonstrate.

International Harvester Co.
180 North Michigan Ave.
Chicago 1, Illinois

A COMPLETE POWER PACKAGE

*International*® *Construction Equipment*

**"Boulder-dozing" after blasting—** The TD-25 does some "blasting" itself to move "big-as-a-house" hunks of rock aside. Heavy-duty TD-25 Dura-Rollers defy the rock-dozing "grind"—with the industry's thickest shells to prevent flexing—positive grit exclusion—and 1,000-hr.-interval lube capacity!



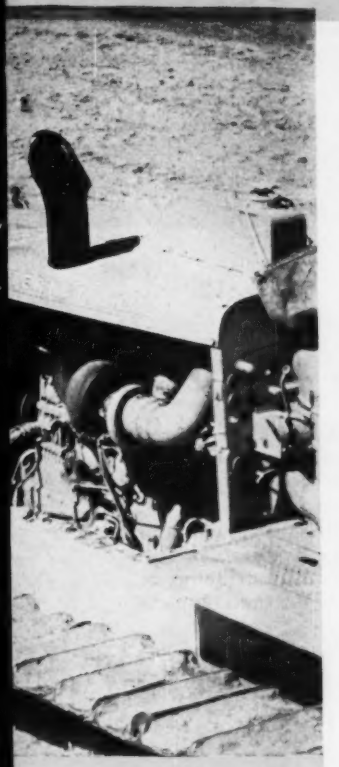

**Here's your 76-page cost and production estimating book**—newest, most authentic and complete guide for estimating material-moving costs—and for selecting equipment combinations for top profits, *anywhere!* Yours for the asking from your International Construction Equipment Distributor!

# over three slam-bang rock jobs

**With the planet-powered** 230-hp TD-25 pushing—and with 375 high-torque International Diesel hp under the "295's" hood—you heap on 34-cu. yd. with amazing new speed. Even in toughest loading conditions, "X"-member reinforcing maintains perfect Payscraper push-frame alignment!

**Note that the Payscraper** apron lifts to a big 94-inch opening. Two ejector-plate pushing members apply dozer-like action to force out the whole 34-cu. yd. load cleanly. The 122-inch bowl width speeds unloading, and loading, too—adds control ease and stability, loaded or empty.

# How Payscraper* power and power controls boost your dirt-on-fill delivery!



**You get highest power-to-payload punch** of all rubber-tired rigs in the 34-cu. yd. International 295 Payscraper. The fast-slugging, high-torque 6-cylinder International DT-817 Diesel is the Payscraper power plant.

The direct-start, 375-hp DT-817 is turbocharged to give you all-altitude, high-efficiency performance—power for cycle-speeding rim-pull—plus time-saving "no-lag" control power!

**You power-shift** the Payscraper, up or down—and the 4-speed planetary-type, torque-converter transmission provides load-speeding *automatic* direct-drive lock-ups in second, third, and fourth gears!

**You power-steer** the 150,000-lb. loaded Payscraper almost as easily as a 3,600-lb. automobile. Payscraper gives you the big control advantages of (1), exclusive International rack-and-pinion plus tandem pump steering system; and (2), 3-degree forward spindle pitch that improves scraper balance and prevents "nose-downs" in high-speed turns!

**You power-control** Payscraper dirt-handling actions with fingertip ease with the International PTO-driven Cable Control Unit. One cable drum of this simple planetary system actuates the apron and ejector; the other drum positions the bowl to control loading and spreading! Reach-easy Payscraper power brakes give you fast, positive stopping!

**Ease into the bump-smothering** Payscraper seat—press the direct-start button—power-shift the outfit into action. Compare the speed of loading, roading, and dumping the 122-inch bowl. See how the advantages of DT-817 Diesel power and complete, positive Payscraper power control can boost your dirt-on-fill delivery. Choose the 2-axle "295," or 3-axle, 34-cu. yd. "495." See your International Construction Equipment Distributor for a demonstration!

**Here's your 76-page cost and production estimating book**—newest, most authentic and complete guide for estimating material-moving costs—and for selecting equipment combinations for top profits, *anywhere!* Yours for the asking from your International Construction Equipment Distributor!

*International®*
*Construction*
*Equipment*

International Harvester Co.,
180 North Michigan Ave., Chicago 1, Ill.

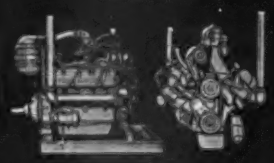
A COMPLETE POWER PACKAGE

**Positive power-control** of all operations adds safety, builds operator confidence — makes him "haul-speed minded" to help you get full capacity and profit from Payscraper speeds up to 33.5 mph. For example, safe, effortless tandem-pump power-steering leaves "the steering feel in the steering wheel"—gives positive, one-hand control!

## CARBURETED

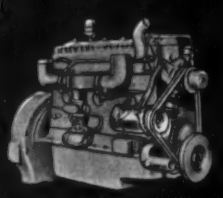
U-1091
248 max. hp. (nat. gas)

UV-549
222 max. hp.

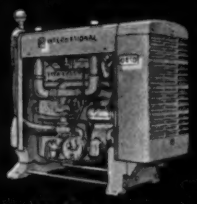


UV-461
179 max. hp.

UV-401
170 max. hp.

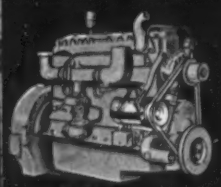


U-501
141 max. hp.



U-450
134.5 max. hp.

UB-264
112 max. hp.



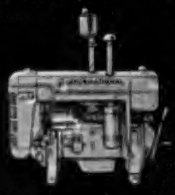
U-372
110 max. hp.

UC-263
95 max. hp.

U-308
92 max. hp.

UB-220
83 max. hp.

UC-221
75 max. hp.



UC-135
42 max. hp.

UC-60
16.5 max. hp.

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# *matches your mining power requirements*

**Wide selection of power** in the International engine line gives you a range to meet all requirements. Choose from 35 engine sizes—16.8 to 385 max. hp—and exactly match the power to the job. Millions of hours of operation in all parts of the world have job-tested International power for every heavy-duty mining application.

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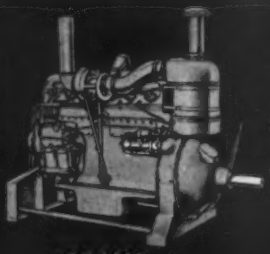
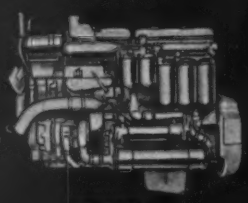
## DIESEL

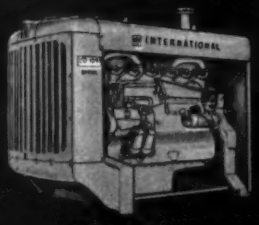
UDT-817
385 max. hp



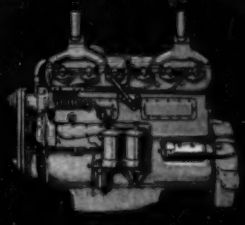
UDT-1091
300 max. hp



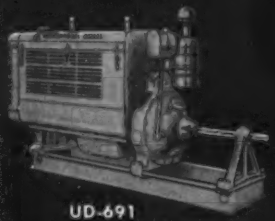
UD-817
250 max. hp



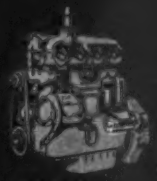
UD-1091
224 max. hp



UD-554
150 max. hp

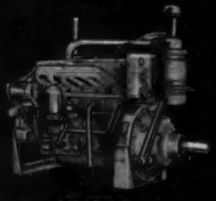


UD-691
150 max. hp



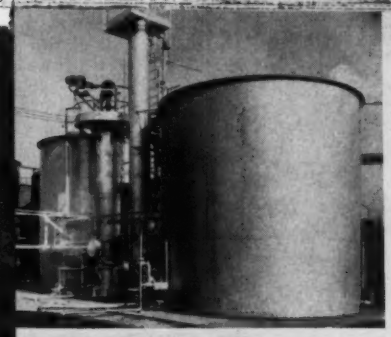
UD-14A
105 max. hp

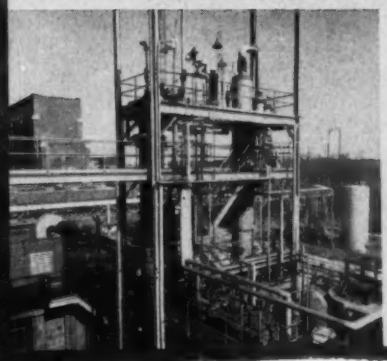
UD-370
105 max. hp



UD-282
95 max. hp

UD-236
75 max. hp





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# CAN YOUR PLANT PROFITABLY USE AN RDC COLUMN?

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Above you see RDC columns in successful operation for manufacturers of chemicals, petro-chemicals, petroleum and foods. Production size or pilot plant models available. Write or phone General American for Bulletin #T-1159. If you wish, our engineers will be glad to discuss your requirements and recommend the equipment that will do your work most efficiently.

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# DOWN GOES CUT-IMPACT DAMAGE

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## U.S. ROYAL SAFETY 1ST TRUCK TIRES

**US United States Rubber**

Rockefeller Center, New York 20, N.Y.

## Nuclear Shaft *(from p 308)*

at Carlsbad, N.M. The shaft is to be sunk about 25 miles southeast of Carlsbad for an AEC underground nuclear blast test under the "Plowshare" program. The device to be tested is reported equivalent to 10,000 tons of conventional explosive, and the test set for 1961.

Apparent low bidder on the job was E. C. Nickel Co., of Arcadia, Calif., who also did the similar job for AEC at the Nevada underground tests.

## Severson Cites Rise In Iron Ore Beneficiation

LLOYD J. SEVERSON, president of Quebec Cartier Mining Co., a $200-million iron ore project of U.S. Steel Corp., sees a new era developing in Canada's iron ore industry.

"In a decade," he said on a visit to Toronto, "most iron ore will be upgraded before shipment."

"This will mean huge added capital investment in our present iron mines and, to a lesser extent, greater mining employment."

Almost a third of all the iron ore fed today into American furnaces has been "beneficiated" in some way to increase the iron content, Severson said.

Quebec Cartier will produce beneficiated ore. Its mill will be capable—about 12 months from now—of treating 60,000 tons of low-grade ore a day and producing 24,000 tons of high-grade concentrate.

"There is no shortage of ore in the world," Mr. Severson points out. "The big problem is efficient transportation and materials handling."

Until recently, the world's steel mills took ore containing from 50 to almost 60% iron. A decade from now, they'll want "60% plus," says Mr. Severson.

The huge enterprise he directs will ship 8-million tons of 66% grade ore, most of it destined for U.S. Steel's own mills. The mines are 360 miles north of Quebec city.

"We expect around 1-million tons will be sold in Canada, and we anticipate sales in Britain particularly and possibly western Europe for the balance," he says.

## U.K. Steel Companies Hike Ore Investments Abroad

BRITAIN'S steel industry is increasing its financial stake in overseas iron ore deposits to meet expansion needs.

In late April nine major companies, along with the British Steel Corp. Ltd., offshoot of the British Iron & Steel Federation, joined forces to form the British Ore Investment Corp. Ltd. (BOIC). The new organization will take over British Steel Corp.'s foreign holdings and handle further investments in foreign ore-supplying companies.

The British iron ore industry's largest

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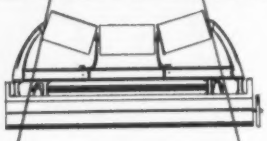

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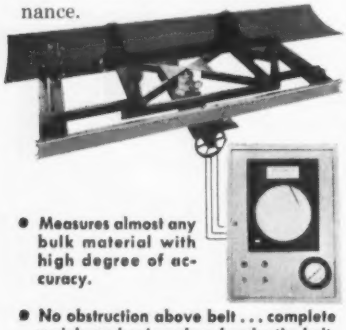
The Con-O-Weigh System offers an entirely new concept in continuous-belt-conveyor weighing — thoroughly job-proven as a control system in industries with problems in feeding, weighing, blending and totalizing of free flowing bulk materials. Consisting of only three major parts — the weigh section, load cell and recording-totalizing unit — Con-O-Weigh features rugged construction and simplicity of design, insuring economical installation and minimum maintenance.



- Measures almost any bulk material with high degree of accuracy.
- No obstruction above belt . . . complete weigh mechanism placed under the belt.
- Design prevents inaccurate torsional pressures, thus eliminating errors resulting from uneven belt loading.

For your specific bulk material weighing problem get the facts on this easy to install machine.

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## UK Steel *(Continued)*

investments are now in West Africa, where British Steel holds a 30.5% interest in Guinea's Compagnie Miniere de Conakry and 20% of Miferma (Societe des mines de fer de Mauritanie) which is spending $168-million to develop deposits. Miferma is expected to supply some 6-million tpy to European users. BOIC will now take over the West African participation.

## Inco Plans New Open Pit New Exploration Shaft

LATE 1961 is the target date for production from International Nickel Co. of Canada's new Clarabelle open pit, southwest of the firm's Murray Mine in the Sudbury District of Ontario.

The Clarabelle, which is partially under Clarabelle and Lady MacDonald Lakes, is to be 2,500 ft long by 150 to 500 ft wide. Parts of the lakes will have to be dammed to permit the operation as envisaged.

Ralph D. Parker, senior vice president, at the visit of Inco directors to Copper Cliff, announced the new project and noted that production from the new pit will replace tonnage now being obtained from other Inco mines. The Frood pit is reportedly nearing depletion, and its major equipment will be transferred to the Clarabelle when the latter is ready. The Frood, which is larger than the proposed new property, is now 600 ft deep and Mr. Parker noted that the Clarabelle would not reach that depth.

Parker also noted that Inco will sink a 3,000-ft shaft north of Copper Cliff for exploration of the "Copper Cliff offset," and stations will be cut at 1,000, 2,000 and 3,000 ft, from which diamond drill drifts will be driven.

## 'Sentinels of Safety' Winners Are Announced

SIX MINES and quarries were named as winners in the 35th National Safety Competition, sponsored by USBM, and received "Sentinels of Safety" awards from EXPLOSIVES ENGINEER for their accomplishment. The winning metal and nonmetallic mines were:

METAL MINES: Wauseca Mine, Hanna Mining Co. (M. A. Hanna Co.), Iron River, Mich., which operated 332,563 man-hours without a disabling injury. This is the first victory for the Wauseca Mine in 17 years of competition.

OPEN-PIT MINES: Rouchleau Mine, Oliver Iron Mining Div., U. S. Steel Corp., Virginia, Minn., which operated 627,409 man-hours without a disabling injury. This was the Rouchleau Mine's second year in competition.

NONMETALLIC MINES (UNDERGROUND): Akron Mine, Bestwall Gypsum Co., Akron, N.Y., which operated 265,192 man-hours without a disabling injury. This was also the second competition for the Akron Mine; it was awarded third place in its group in the 1958 contest.

## Chino Pit Will Install $2-Million Skip System

CHINO MINES DIV. of Kennecott Copper Corp. will install a $2-million skip hoist at its Santa Rita open cut mine, capable of removing 18,000 tpd of waste and ore.

The new hoist, similar to installations at Liberty Pit of Nevada Mines Div., Kennecott Copper Corp., will eliminate nine miles of railroad haulage. Rail haulage will continue elsewhere in the pit.

The hoist will go to deepest portion of the open cut mine and will run from pit lip 600 ft to pit center at a 30° incline.

Chino now mines about 22,500 tpd of ore and nearly 50,000 tpd of waste from mine at present.

## South Africans Speed Shaft Sinking Rates

THE FANTASTIC OUTLAY of capital on the development of modern gold mines has prompted a speeding-up of shaft-sinking tempos. Earlier this year, President Steyn, one of the Orange Free State mines, set up the existing shaft-sinking

LESCHEN WIRE PORTER ROPE DIVISION
H. K. PORTER COMPANY, INC.

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## ...the most effective classifier for a wide range of applications

- ✓ LOW INITIAL COST
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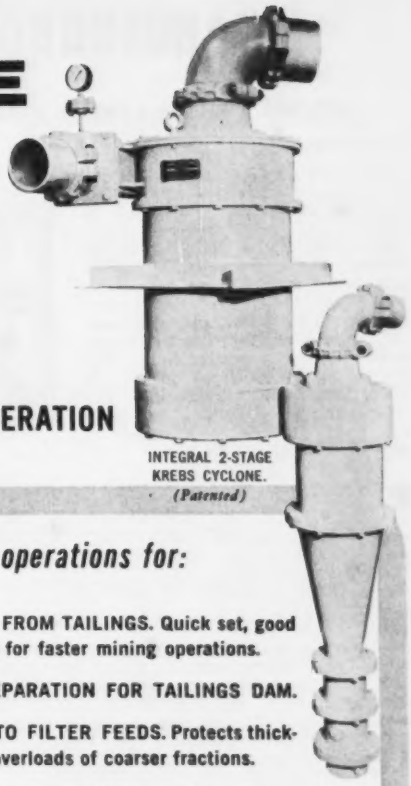
- ✓ GREATER RUNNING TIME (No grind-out required)
- ✓ METALLURGICAL GAINS OFTEN OF MAJOR CONSIDERATION



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- CLOSED-CIRCUIT CLASSIFICATION IN PRIMARY MILLS.
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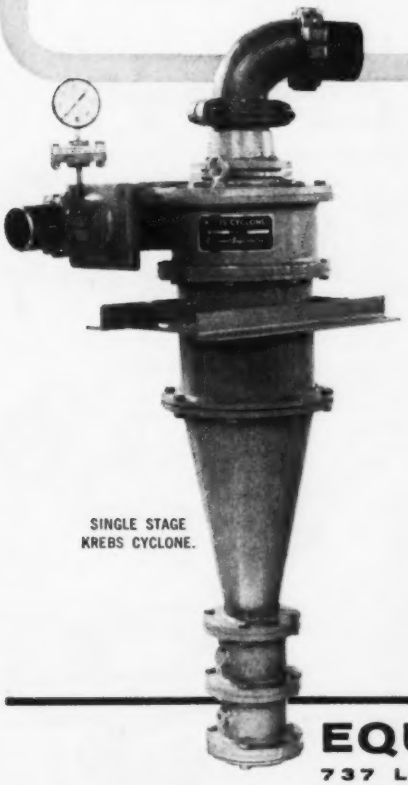
- ADJUNCT TO FILTER FEEDS. Protects thickener from overloads of coarser fractions.
- DESANDING MINE WATER. Reduces pumping maintenance substantially.
- OTHER SPECIAL APPLICATIONS.



SINGLE STAGE KREBS CYCLONE.

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**THE PILOT PLANT AT PALO ALTO** is equipped for full-scale testing programs. Results are correlated with a large tabulation of data from other tests and subsequent installations and accurate performances are predicted. This work often leads to economies and metallurgical gains.

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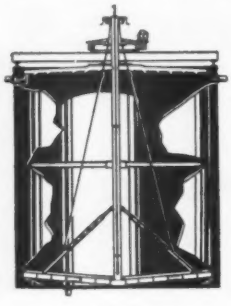
### AGITATING

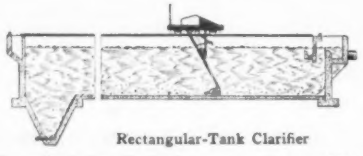
Hardinge combined mechanical and air Agitators are used to mix, agitate or store clay slurries, as well as metallurgical and chemical pulps. Compressed air is delivered to the bottom of the torque tube (which acts as an air lift) and to various points near the ends of the rotating scrapers. Pulp is fed and withdrawn continuously or intermittently, as desired. The drive mechanism is supported on ball bearings in an oil-filled, totally enclosed housing. The scraper raising winch is in easy reach and away from possible splash of pulp. Bulletin 31-E-1.



Agitator

### CLARIFYING

For industrial water supply or liquid waste treatment, Hardinge offers clarifiers for both circular and rectangular tanks. The rectangular tank unit is especially suited for limited spaces. A traveling scraper and skimmer carriage travels the length of the tank, running on rails mounted on both sides. Cost of the mechanism does not increase with tank length. Circular-tank units are also available for continuous removal of settling-tank solids, similar in construction to the Hardinge Thickener, (see next page) Bulletin 35-D-1.

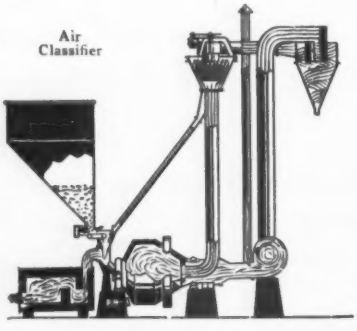


Rectangular-Tank Clarifier

### CLASSIFYING • SEPARATING

#### Dry Classifiers

**The Hardinge "Gyrotor Air Classifier,** operating in conjunction with the Hardinge Mill, is a compact, self-contained unit of unusual efficiency. The material is conveyed without auxiliary apparatus to any convenient location in the building. The Hardinge "Gryrotor" Air Classifier provides extremely close product control. Bulletin 17-C-1.



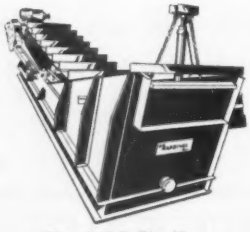
Air Classifier

#### Wet Classifiers

**The Hardinge Hydro-Classifier** is a large-volume classifier for fine separating problems. Bulletin 39-C-1.

Hydro-Classifier

**The "Overdrain" Classifier** is a completely new device. A belt, with lifting flights attached beneath, moves upwardly out of the sand bed between two stationary side shrouds, creating the effect of a series of moving, closed, washing compartments. The only outlet from these compartments is via holes in the belt above. Surplus liquid and slimes discharge through these "overdrain" holes without mixing with the oncoming sands. Extremely clean sand discharge, excellent de-sliming — an ideal washing device. Bulletin AH-478-1.



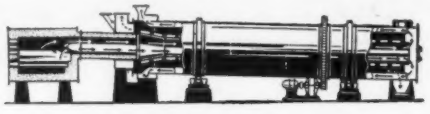
"Overdrain" Classifier

### COOLING

**Ruggles-Coles Rotary Coolers** are employed for cooling hot materials after high temperature drying or calcination. There are four types: the gas-cooled type, the water-cooled shell type, the internal water-tube type, and the direct-contact water type. Bulletin 16-D-1.

Rotary Cooler

### DRYING



Class XB Double-Shell Rotary Dryer

There are six different types of Ruggles-Coles double and single-shell continuous Rotary Dryers, designed for direct, indirect and steam heat. Bulletin AH-438-1.

**Class XA**—This double-shell, semi-direct-heat dryer has the highest thermal efficiency and lowest fuel consumption of any rotary dryer manufactured. Particularly adapted for coal drying.

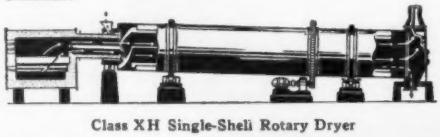
**Class XB**—A double-shell, indirect-heat dryer designed to handle such materials as Kaolin, chalk, whiting, china clay, pigments, fuller's earth.

**Class XC**—A rotary steam tube dryer for drying materials that are injured by high temperature such as brewer's grain, cotton seed, starch feed, tobacco stems and corn germs.

**Class XF**—Single-Shell, counter-flow dryer for high drying temperatures.

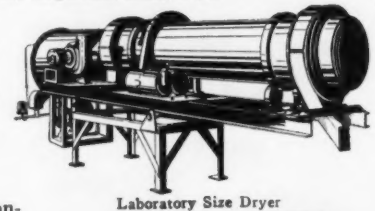
**Class XH**—A single-shell, parallel-flow dryer, especially designed to handle flotation concentrates without sticking and without excessive dust loss.

**Class XW** —Used almost exclusively for drying inorganic salts and similar materials. It is a single-shell dryer with steam coil heating element.



Class XH Single-Shell Rotary Dryer

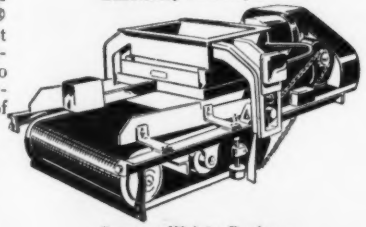
For pilot-plant or laboratory drying operations, Hardinge offers three styles of small, self-contained units, the XH-XF unit, the XB and the XC units.



Laboratory Size Dryer

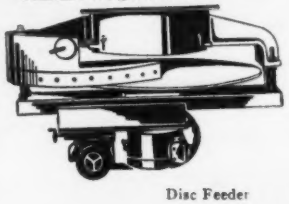
### FEEDING

**The Hardinge Constant Weight Feeder®** measures by weight, not volume, thus compensating for variations due to changes in specific gravity, bulking or size of material. The feeder is quite accurate, and it affords automatic feed control for crushers, pulverizers, mixers, dryers, kilns, furnaces and conveyors. The feeder is bin-supported, requires little headroom. Bulletin 33-E-1.



Constant-Weight Feeder

**The Hardinge Disc Feeder** is outstanding in its simplicity, sturdiness and ease in adjustment. Particularly suitable for handling bulky, sticky, hot materials. Bulletin 33-E-1.



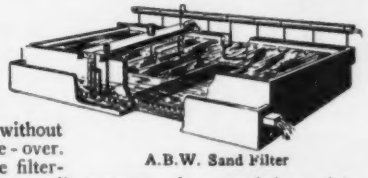
Disc Feeder

# HARDINGE COMPANY, INCORPORATED

YORK, PENNSYLVANIA

NEW YORK • TORONTO • CHICAGO • HIBBING • HOUSTON • SALT LAKE CITY • SAN FRANCISCO • LAKELAND • BIRMINGHAM

**FILTERING**

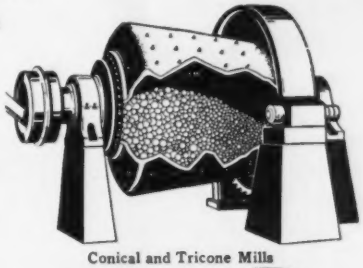


A.B.W. Sand Filter

**The Hardinge Automatic Backwash Rapid Sand Filter** cleans its own filter bed, a section at a time, automatically, without shut-down or change-over. Primarily adapted to the filtering of water containing small amounts of suspended particles that cannot be properly collected in settling basins or clarifiers. Used for filtering municipal water supplies, industrial water supplies, and certain presettled industrial waste waters to permit their re-use. Bulletin 46-A-1.

**GRINDING—PULVERIZING**

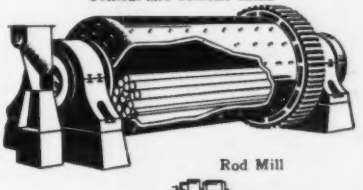
**Conical Mills**



Conical and Tricone Mills

The shape of the Hardinge Conical Mill causes a rapid circulating and classifying action within the drum, maintaining the large balls at the feed end of the mill for maximum grinding efficiency. Dry grinding applications — Bulletin 17-C-1; Wet grinding—Bulletin AH-389-1.

**Tricone Mills**



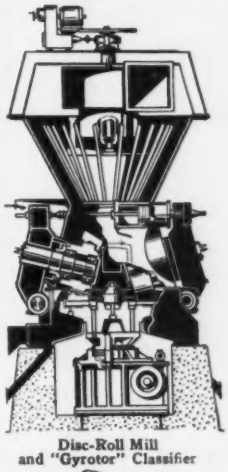
Rod Mill

Built on the same principle as the Conical Mill, the Tricone Mill offers greater grinding volume for a given amount of floor space than any other tumbling mill built. Extremely efficient. Ideal for large tonnages. Sizes up to 12 ft. diameter. Bulletin AH-414-1.

**Rod Mills**

Steel rods are employed as grinding media. **Ideal for producing minimum oversize in open circuit grinding.** Conical heads reduce friction, prevent congestion of charge at the ends, **and align the rods. Available** with either end, or center, peripheral discharge, as well as trunnion overflow. **Bulletin 25-C-1.**

**Disc Roll Mills**

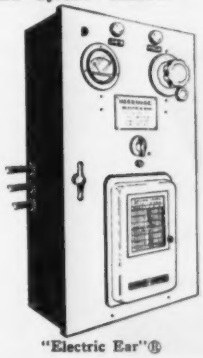


Disc-Roll Mill and "Gyrotor" Classifier

An adaptation of the German "Loesche Mill." A roller-mill with rotating grinding table and **pneumatically-loaded rolls for complete** flexibility of operation. The "Gyrotor" Classifier, combined with the Disc Roll Mill, provides a highly-efficient dry-grinding device, ideal for relatively soft minerals. Bulletin 52-1.

**GRINDING CONTROL**

**"Electric Ear"®**



"Electric Ear"®

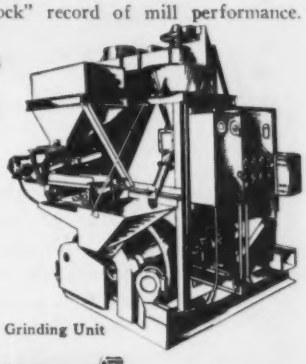
**A revolutionary principle of control that automatically regulates the feed** rate of a mill to keep it operating at maximum efficiency by "listening" to the sound. Mill capacity is increased **10% to 20%.** Now available with built-in, continuous sound-recording charts. **Bulletin 42-A-1.**

**GRINDING SOUND RECORDER**

Portable Sound Recorder

**The Hardinge Portable Sound Recorder** can be used in checking the efficiency of grinding mill operation. It may also supplement existing "Electric Ear" installations by maintaining an "around-the-clock" record of mill performance. Bulletin AH-480-1.

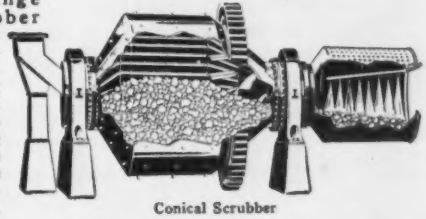
**LABORATORY GRINDING UNITS**



Dry Grinding Unit

For any small-scale continuous grinding operation, either wet or dry, Hardinge offers a completely self-contained and portable unit which provides all the functions of feeding, grinding, and classifying found in a large-scale system. Complete controls and wiring provided. Just "plug it in." Bulletin AH-448-1.

**SCRUBBING**



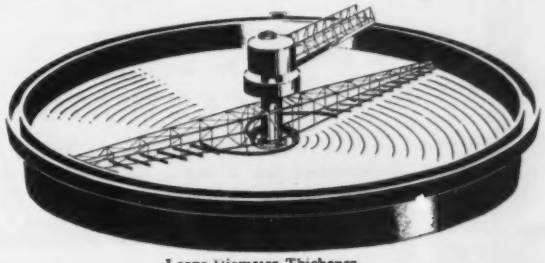
Conical Scrubber

**The Hardinge Conical Scrubber** cleans by mass contact and natural displacement. This action removes dirt and silt without wear on the scrubber. The classifying action of the cone holds back the large clay balls until properly disintegrated. Foreign materials, such as sticks, vegetation or large pieces of metal, can do no harm. Power required is low, and water requirements are considerably less than that of other methods. Repair costs are negligible. Bulletin 37-B-1.

**THICKENING**

The distinctive features of the **Hardinge Thickener** are the spiral scrapers, which clean the bottom of the tank with each revolution, and the "Auto-Raise" driving mechanism which automatically lifts the scrapers away from an overload or obstruction in the tank bottom, thus eliminating costly breakdowns and delays. Can be operated very slowly, causing a minimum of disturbance. Produces a clearer overflow and a thicker discharge than other types. Small thickener mechanisms are supported on beams, spanning the tank. The large units carry the mechanisms on a central concrete pier. Bulletin 31-E-1.

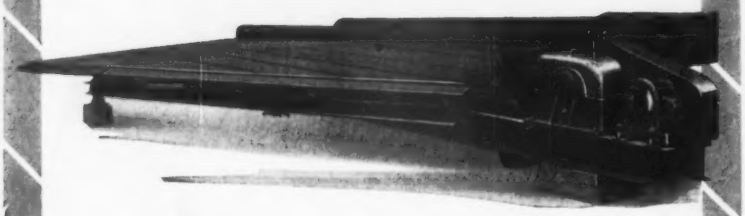
Small-Diameter Thickener



Large-Diameter Thickener

LOCAL OFFICE PHONES: YORK, PENNA.—YORK 33-821; NEW YORK — OXford 7-3590; TORONTO — EMpire 3-5692; CHICAGO — FRanklin 2-4182; HIBBING, MINN.—AMhurst 2-2825; HOUSTON—JAckson 3-1733; SALT LAKE CITY—HUnter 4-5151; SAN FRANCISCO —YUkon 2-6920; LAKELAND, FLA.—MUtual 65135; BIRMINGHAM—ALpine 1-9262.

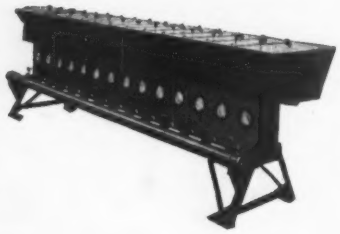
# SuperDuty® DIAGONAL-DECK® Table Leads in Mineral Concentrating Efficiency



In the economic production of high grade concentrates at maximum recovery with minimum loss to tailings the DIAGONAL-DECK table represents the most efficient and most economical table or process operating in the field today.

This outstanding efficiency is a result of a complete balancing of all tabling factors, starting with the deck itself, which is designed to present the most effective use of working riffles in the natural path of material flow. This with the action of the smooth anti-friction bearing head motion means higher grade concentrates, minimum circulating of middling loads, and maximum reduction of loss to tailings.

For complete explanation of this and other factors, send for bulletin 118C



CONCENCO®
Type "CPC" Classifier

This all steel Constriction Plate Classifier is available in 1 to 10 or more cells. Novel secondary classification sharpens the separations made by each main cell. Advantages offered are: (1) accurate classification or sharp sizing, (2) easy and effective hydraulic water regulation, (3) as many spigot products as there are cells, (4) continuous discharge, (5) no moving parts, (6) low maintenance cost.

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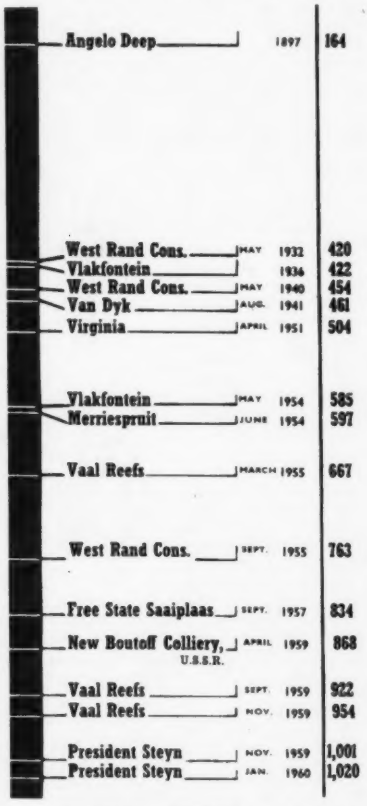
CONCENCO PRODUCTS

★ *The ORIGINAL Deister Company* ★ *Inc. 1906*


## Shaft Record *(Continued)*

record of 1,020 ft in a month, the culmination of concentrated efforts over previous months in which South African teams broke the Russian record several times.

But now South African mining chiefs and technical experts are setting their sights on new and ambitious targets. It is reported that Hartebeestfontein mine, an Anglo-Vaal property in the Klerksdorp area of the Western Transvaal, is


Angelo Deep 1897 164
West Rand Cons. MAY 1932 420
Vlakfontein 1936 422
West Rand Cons. MAY 1940 454
Van Dyk AUG. 1941 461
Virginia APRIL 1951 504
Vlakfontein MAY 1954 585
Merriespruit JUNE 1954 597
Vaal Reefs MARCH 1955 667
West Rand Cons. SEPT. 1955 763
Free State Saaiplaas SEPT. 1957 834
New Boutoff Colliery, U.S.S.R. APRIL 1959 868
Vaal Reefs SEPT. 1959 922
Vaal Reefs NOV. 1959 954
President Steyn NOV. 1959 1,001
President Steyn JAN. 1960 1,020

**INCREASING SPEEDS** attained by shaft-sinking crews in South Africa and at the USSR Boutoff Colliery are shown in the column at right. Depth is shown in footage per month. (Diagram courtesy of Transvaal and Orange Free State Chamber of Mines.)

now aiming to clock up 1,200 ft in a single month later on in the year. And officials in several mines seem to think that teams in this country will be breaking the 1,400 ft mark in the foreseeable future.

Shaft-sinking at speed is naturally a costly operation. The master shaft-sinkers, working on a wage-plus-bonus principle, can earn something approaching £1,000 a month. Those harddriving individuals can probably pick up between $25,000 and $30,000 a year.

There are, in addition, the teams of unskilled laborers, usually nuggety, cheerful Basutos working round the clock in successive shifts, drilling, blasting and cleaning. They will strive to cut two or three minutes off a particular

Bethlehem roof bolts clamp rock strata together to improve the safety in this coal mine.

# Keeping the roof safe

The proved way to make your roof sound—and keep roof falls to a minimum—is to install bolts in the correct pattern for local conditions. This includes both stratified and massive rock formations.

Who figures this out? Who works right along side your team during the installation? Who checks back, at specified periods, to test and inspect? Your Bethlehem contact man. He'll come see you. Just tell us where and when.

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*for Strength*
*... Economy*
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# SAUERMAN NEWS briefs

SAUERMAN BROS., INC.,
626 South 28th Avenue, Bellwood, Illinois
Linden 4-4892

## Cableway-DragScraper Blends, Reclaims Stockpiled Ore

Over a million tons of iron ore may be stockpiled in the new facilities of a South American mining company. The DragScraper permits better blending of the ore and reclaims all stockpiled material that does not flow by gravity into two 3000-ftph. tunnel conveyors.

The 10-yd. Dragscraper is suspended from a carriage traveling on a track cable between two self-supporting towers. These travel on tracks paralleling the storage area. Despite the size of the Sauerman installation, it may be controlled by one man.

*(Condensed from a forthcoming Sauerman News)*

## Efficient Slag Removal

A 4-yd. Sauerman DragScraper machine is incorporated in the waste slag disposal system of a large copper smelting operation. The slag is flumed into two dewatering tanks separated by a common wall. After a tank is drained, the slag is reclaimed by the DragScraper to a hopper at the head end. The DragScraper is remotely operated from a station above the hoist to provide good visual coverage of the installation.

The monorail-trolley assembly at the tail end provides lateral movement of the DragScraper. The monorail spans the tanks, and a Durolite single block on the trolley carries the backhaul cable. Shifting is handled by a motorized winch remotely controlled by the hoist operator.

The DragScraper reclaims to the hopper at about 250 tph. The hopper, in turn, feeds a conveyor belt which carries slag to the disposal area.

*(Condensed from Sauerman News No. 155)*

## Handling Phosphate Ore

Ore concentrate is stockpiled and reclaimed as required to the foot of a bucket elevator by a Sauerman DragScraper Machine at a Southern chemical plant.

A self-propelled tail tower travels around the perimeter of the stockpile. The tower is shifted to change the line of operation. DragScraper haul length is 400 ft. The operator's station for the Sauerman hoist is located above the conveyors to give a clear view of the pile.

*(Condensed from Sauerman News No. 151)*

**MORE NEWS AND INFORMATION**

*Issues of Sauerman News giving greater detail about the installations on this page are available on request. For more information on your materials handling requirements, contact Sauerman Bros., Inc., 626 S. 28th Ave., Bellwood, Ill. Linden 4-4892.*

## Shaft Sinking *(Continued)*

operation to get more and more footage in a month's effort. The black men are the elite of the laborers and they are also individually on a wage and bonus basis. There are, too, the European assistants to the master sinker, all drawing comparatively big pay.

But mine managements shell out cheerfully for footage sunk at driving speed. For with a modern South African mine the capital needed to get it to the productive stage can be anything between £8-million ($22.4-million) and £10-million and investors want to start getting their money back as soon as possible. Western Deep Levels, Anglo American's new project on the Far West Witwatersrand, will involve its sponsors in an outlay of £25-million ($70-million) before it produces gold from the rich reef.

## First International Symposium in U.S. Set

THE AIME will sponsor the first U.S.-held international symposium, of the type which has been conducted in Stockholm and London in recent years and in India several months ago. Philadelphia is the site of the International Symposium on Agglomeration, planned for April 12-14, 1961.

The symposium, which is expected to draw top authorities from all over the world, will specifically deal with the processes of sintering, pelletizing, nodulizing, briquetting, powder metallurgy, ceramic bonding and related processes. Emphasis, according to the sponsoring society, will be principally on fundamental aspects of agglomeration.

Notably, the symposium will use the technique of publishing pre-prints of the papers and mailing them to pre-registrants sufficiently ahead of the meeting so that time at the symposium can be devoted to discussion and not to reading a prepared text. This system, and the idea of no simultaneous sessions, which will also apply at Philadelphia, has met with great favor among industry members.

# IN THE U.S.

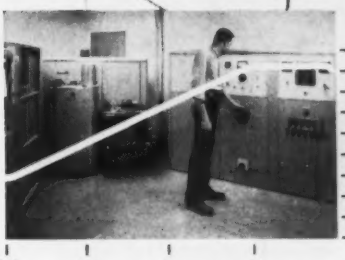
## ALASKA

**Bear Creek Mining Co. will continue its drilling and other exploration work** north of the Kobuk River in the Ruby Creek area this year for the fourth season. In a paper delivered at the recent fifth annual Alaskan Mining, Minerals, & Petroleum Conference held at College, R. H. W. Chadwick, Kennecott geologist, gave some facts and figures on the project.

Over 27,000 ft of diamond drilling to depths as great as 1,600 ft has been accomplished thus far at about $7 per ft. The cost of boarding the crew was

# NACO ALLOY BALLS

*through closer metallurgical control*



| ROCKWELL | BRINELL |
|---|---|
| 63 | 710 |
| 61 | 670 |
| 59 | 638 |
| 57 | 601 |
| 55 | 555 |
| 53 | 534 |
| 51 | 495 |
| 49 | 477 |
| 47 | 444 |
| 45 | 429 |

1½ 1⅛ ¾ ⅜

Distance from surface—inches

*tumble per-ton grinding* *costs*

Through precise laboratory controls of the elements in steel making — from spectrographic analysis through final heat treating — Naco Grinding Balls possess the correct structure and hardness for maximum impact absorption and wearing qualities. Structurally, Naco Grinding Balls have a grain akin to tool steel — tough, hard and rugged. Laboratory tests show remarkable uniformity in solidity and controlled hardness holding to desired depth. Every day more mill operators are tumbling to the cost-saving advantages of Naco Grinding Balls.

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# Here's where to get your best buys in used equipment!

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Used Equipment Manager,
Hoover Equipment Company,
Caterpillar Dealer
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"This is a section of our used equipment lot—one of over 300 Caterpillar Dealers' lots in the U. S. Right here, as in any of the others, you can find the used machine you want for the purpose you want at a fair, realistic price. What's more, you don't buy 'blind.' We recondition, classify, label and *guarantee* our trade-ins. *We* know what you're buying... *you* know what you're buying.

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1 A 'BONDED BUY' Cat-built machine, with a warranted value up to $10,000—it guarantees satisfactory equipment performance and supplies free of charge *all* parts and labor on the machine during the guarantee period.

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"Regardless of the type or kind of equipment you buy, we want it to earn money and pay off for you with satisfactory performance. We back every machine with prompt service and parts you can trust. Believe me, all Caterpillar Dealers do. Every Caterpillar Dealer offers the best buys in used equipment. You'll find him listed in the Yellow Pages!"

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BEST USED EQUIPMENT BUYS ANYWHERE


## Alaska *(Continued)*

quoted at an amazingly low figure of $4.60 per man per day, including cook, fuel and air freight from Fairbanks. Chadwick emphasized strongly that mechanized exploration in Alaska need not be expensive provided detailed plans are made a year ahead. He estimated that capital construction costs (if any) would be about 70% above those in other states, and operating costs would be about 30% above those in the "old country," averaging out over-all about 1.5 times the costs of the other states. Therefore, he concludes, for operations in the Kobuk, "If you can see a large tonnage potential, with a grade of 1.5 times Stateside operations then don't walk off arbitrarily; wait for the assay returns to scare you off." He concluded further that there is ore to be found in Alaska if it doesn't become burdened (by taxes and other costs) into the category of waste.

**Columbia Iron Mining Co. is doing further drilling** on its Union Bay magnetite deposit. At present, an independent contractor is working there with small pack type drills and getting a satisfactory 96% core recovery to depths of 100 ft.

## ARIZONA

**Grand Junction Operations Office of Atomic Energy Commission has given a reserve allocation to Western Gold & Uranium Corp.'s Orphan mine** on south rim of the Grand Canyon.

While the allocation under the 1966 domestic purchase program still must be approved by the AEC in Washington, it amounts to more than 500,000 tons of ore. Western Gold itself had estimated its ore reserve at the unusual deposit at around 600,000 tons.

According to Max E. Kofford, chief geologist for Western Gold, a part of the reserve is claimed by either the National Park Service or AEC itself—depending on what happens to legislation in the Senate affecting the orebody.

However, Kofford asserts that Western Gold attorneys believe the firm has a clear apex right on the ore deposit of volcanic origin 400 ft up from the bed of the Colorado River on the south wall of the Grand Canyon.

The situation appears generally to be this: below the 400 ft level (the zero level in the mine) the deposit widens out and a part of it runs off the end lines of the claims into the Park Service ground. Sen. Barry Goldwater (R.-Ariz.) has introduced legislation compromising the dispute between the firm and the Park Service by deeding surface rights to the patent claims to the Park Service. The ore would go to the company. However, AEC's Grand Junction office has ruled informally that it cannot do business with another government agency in this regard and that ores in the Federal domain under these circumstances is the property of the Commission.

Discussions are now under way with view to resolving the conflicts amicably, if possible.

PHONE: SCRANTON, PENNSYLVANIA

# DIAMOND 4-8506

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### MACHINES

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Four matrices . . . three grades of diamonds . . . seven ranges of stone size. Out of the many combinations possible, there is the right bit for your particular job. Give us all of the particulars and we will assist you in choosing the bit we believe best suited for your work.

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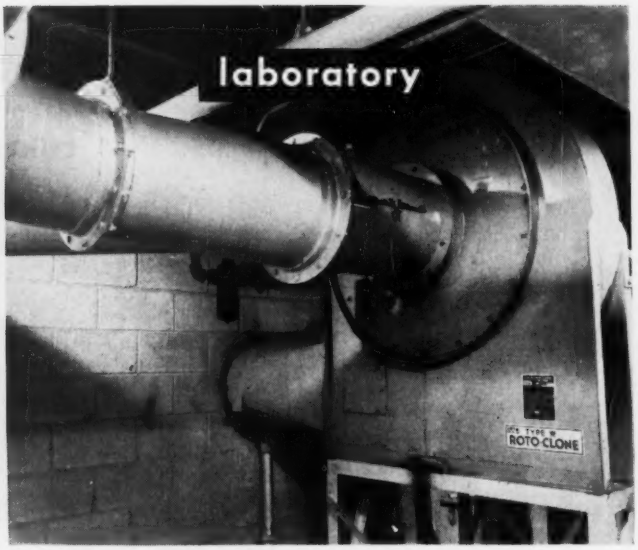
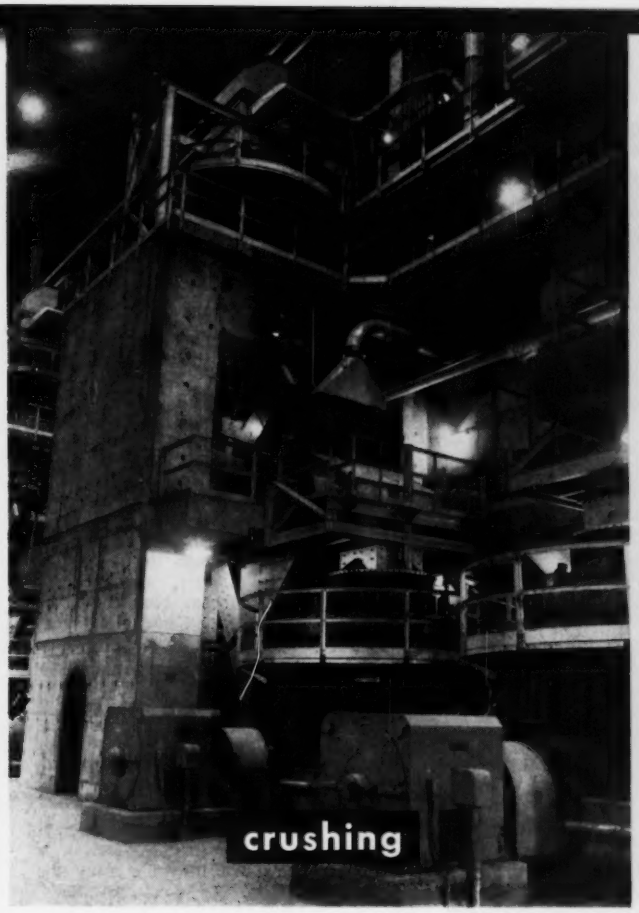
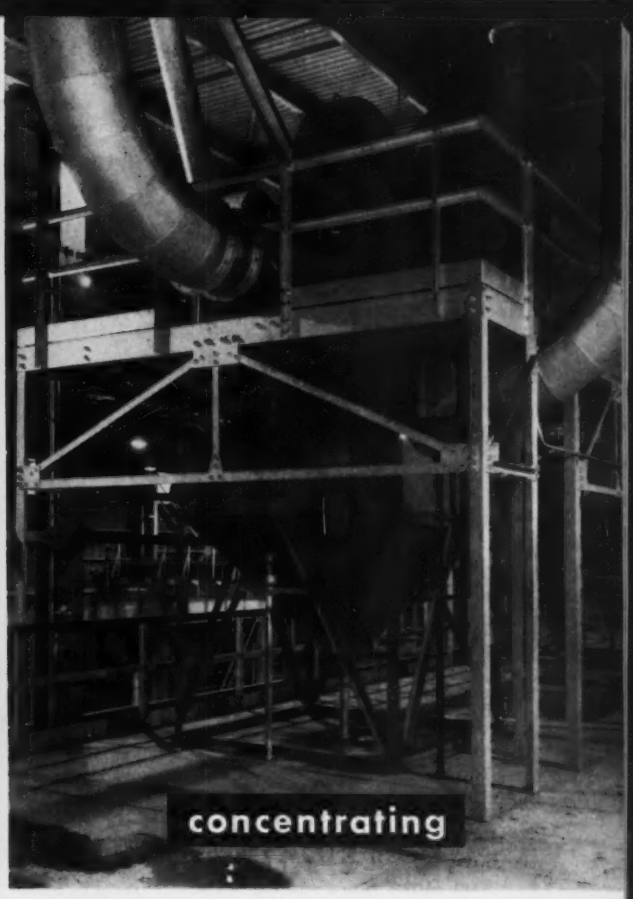
# AAF dust control "rides herd"

AAF Type N ROTO-CLONE exhausting bottom discharge of pelletizing furnace. It's one of 35 Type N's at this installation exhausting pelletizing furnaces, coal dryer and transfer points.




Type W ROTO-CLONE exhausting dust-producing operations in laboratory. It's one of 30 Type W units at this plant. Others exhaust crushing, screening, transfer and bin ventilation operations.




# on tough taconite ore!

## All operations dust-proofed by 65 AAF ROTO-CLONES (1,100,000 cfm!)

Dust never shows its face in this modern taconite processing plant. From the first transfer point, through crushing, concentrating and pelletizing, it's under the complete control of two types of rugged AAF ROTO-CLONES—the Type W and Type N.

These collectors have been dust-proofing taconite since 1947, and are now used by *all* major processors. The Type W combines the principle of dynamic precipitation with dust-trapping water sprays. The Type N combines centrifugal force with the thorough intermixing of water and dust-laden air. *Both* offer (1) small space requirements, (2) maintained performance, (3) constant exhaust volume, and (4) high collection efficiency.

For more information on these wet-collecting ROTO-CLONES, call your nearest AAF representative or write for Type W Bulletin 274 and Type N Bulletin 277. Address: Mr. Robert Moore, American Air Filter Company, Inc., 193 Central Ave., Louisville, Kentucky.

AAF American Air Filter
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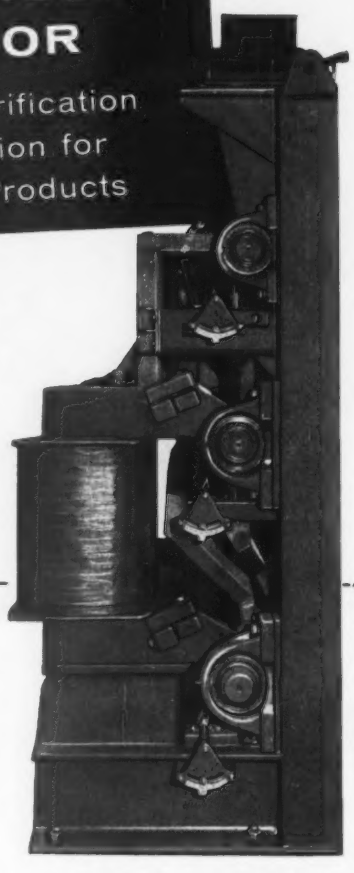
## DINGS INDUCED ROLL SEPARATOR

High Intensity Purification and Concentration for Higher Quality Products

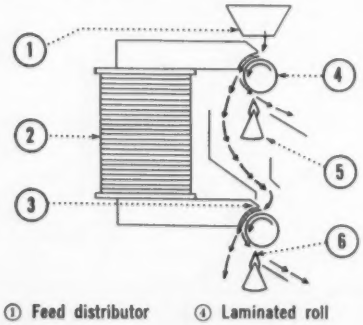


Here's the way to cut beneficiation costs and make greater profit with highest quality products. The newly improved design of Dings Induced Roll Separator permits highest capacities in separation of weakly magnetic materials. New pole nose contour attains tremendous magnetic intensity at separation zone. Adjustable knife-edge dividers assure extremely critical separation.

Result: In beneficiation of nearly every type of dry, granular material, you get higher quality product . . . in greater volume . . . at lower cost!

**You *Make More Money* with these improved features**

- New pole nose contour provides maximum intensity through 37.5 degrees of rotor arc
- Increased flux density from new magnetic circuit
- Magnet coil of anodized aluminum wire for longer life
- New vernier dial for accurate divider settings
- New slim-line frame design saves 52% of floor space
- Bearings are self-aligning, sealed, anti-friction type
- New feed distributor has no moving parts
- Efficient separation at capacities up to 800 lbs. per inch of rotor width per hour.




① Feed distributor ④ Laminated roll
② Magnet coil ⑤ Vernier dial
③ Magnet pole nose ⑥ Knife-edge divider

**HERE'S HOW IT OPERATES**

Material flows over the roll and through the smallest possible air gap between roll and pole nose. High intensity magnetic field lines passing through the air gap converge on the numerous edges of the laminated roll and deflect weakly magnetic particles in the direction the roll is turning. Non-magnetic particles follow a normal trajectory. Adjustable divider cleanly separates magnetics and non-magnetics. Intensity of each roll can be altered to control the amount of magnetics removed. Dings IR Separators available with 1 to 7 rolls in 2" to 30" widths. Write for complete details.

**DINGS MAGNETIC SEPARATOR COMPANY**

4716 W. Electric Ave., Milwaukee 46, Wis.

Dings


## Arizona *(Continued)*

Mr. Kofford disclosed that in recent months, Western Gold has been shipping at rate of 7,000 tons monthly of 0.30% $U_3O_8$ ore, largely to the Tuba City mill of Rare Metals Corp. of America.

The ore reserve allocation approved to date by AEC gives Western Gold some 297,000 tons of 0.37% $U_3O_8$ on its claims and an additional 228,000 tons of like grade ore is in the apex dispute area.

Establishment of ore reserves at the Orphan Mine is important to the negotiations of rare metals with AEC in regard to extension of contracting at the Tuba City mill.

While mining for the last two years has been carried out via an 1,800 ft aerial tramway running about 1,500 ft down the rim of the canyon to the 400 ft level, a modern 1,590 ft, steel-lined 2½ compartment shaft has been completed for Western Gold by Centennial Development, Eureka, Utah, mine contractors.

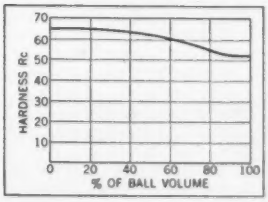
Also, the practice of hauling out waste 11 miles from the mine, as required by the Park Service, has been all but discontinued because of cost. Instead, the firm is mixing the waste with the high grade and shipping the whole of it to Tuba City.

This accommodates that mill to a certain extent. But there are times, says Mr. Kofford, when the firm feels it is "mining waste and throwing away the ore."

LESCHEN WIRE PORTER ROPE DIVISION

H. K. PORTER COMPANY, INC.

**Immediate delivery on USS Grinding Balls** We swing into action immediately when you order USS Grinding Balls. Thus, they are delivered to you when you need them. We can ship promptly from stock that includes a complete range of sizes from ¾″ to 4″ in USS Carbon-Manganese Steel and USS Alloy Steel. Here are three reasons why USS Grinding Balls are your best buy: **Maximum hardness** combined with superior toughness. **Deeper hardness penetration** achieved by careful combination of heat treatment and composition. **Uniform roundness** from ball to ball, load to load, for less wear and superior performance. If you have a delivery, performance, or selection problem, call our nearest Sales Office or United States Steel, 525 William Penn Place, Pittsburgh 30, Pennsylvania.

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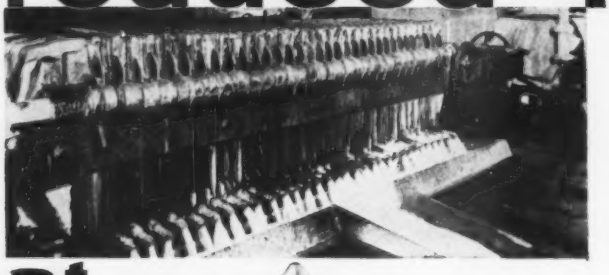
USS

# annual filter paper costs reduced 41%



# at ANACONDA® with NETONE FILTER PAPER

- *Netone has service life of 12 cycles (old paper lasted one cycle)*
- *Easier to put on filter press, less installation damage*
- *Shows excellent resistance to solution shock*

At The Anaconda Company, Electrolytic Zinc Plant, located at Anaconda, Montana, Netone filter paper has been used exclusively on the Shriver filter presses since January 1, 1955. Netone is a heavy, neoprene filled paper possessing remarkable wet strength characteristics.

Prior to the use of the Netone paper on the Shriver presses, it was necessary to discard the kraft paper sheets then in use each time a press was cleaned. The life of the Netone paper in the same service is an average of 12 press cycles. Due to its greater wet strength, the Netone paper is less apt to be damaged during installation and has greater resistance to rupture from solution shock when the press is put in service.

Annual filter paper costs have been reduced 41%. The savings in labor and filter down time are also considerable.

Why not try NETONE Filter Paper on your filter? Test samples on request, no obligation, of course.

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Houston, Texas, 1607 Jefferson Avenue


## Arizona *(Continued)*

Mining practice is varied because of the necessity of accommodating operations to configuration of the deposit.

Where possible, and if necessary, the waste is placed in mined-out ore stopes.

In the past, the firm was paid for some copper in its uranium ore when shipments went to the Mexican Hat mill of the Texas-Zinc Minerals Corp. in San Juan County.

## COLORADO

**Silver Plume Mining Co. has put together a group of some 300 mining claims** and has started blocking out known orebodies in the Burleigh Tunnel, one of the most famous of the early-day mines in the Silver Plume area of Clear Creek County.

The mining company is headed by Dr. H. M. Hoxsey of Dallas, president of the Hoxsey Oil Co. J. W. McCormick Jr., also of Dallas, is executive vice president and general counsel. McCormick is establishing residence at Georgetown to direct operations. Robert L. Jones, a Leadville mining man has been hired as general manager and Roy Walcott of Idaho Springs as superintendent.

**W. D. Fenicle and Wilbur Gorden, Idaho Springs mining men,** announced they acquired the Champion Mine, an extension of the well-known Donaldson vein, three-quarters of a mile up Trail Creek.

They said they hope to open one of three tunnels driven into various levels on the mountainside. This would enable a thorough sampling of the ore.

**The Alta-St. Louis Mine has been purchased** from Mrs. Grace Wagner of Montrose by Silver Mountain Mining Co., Peoria, Ill.

Donald J. Risser, Silver Mountain president, said the firm would start work as soon as surface conditions permit. The property includes 47 patented mining claims and 49 unpatented claims. A 100-ton mill is planned when the property has been rehabilitated.

**Gunnison Mining Co. is starting exploration work** at the California Mine on Flagstaff Mountain, 40 miles north of Saguache in western Colorado.

Gunnison, part of the Thornburg mining interests, purchased the California properties from Walter Timney of Las Vegas, Nev., last September. Inclement weather and deep snow has prevented the start of operations until now.

The mine, inactive for many years, formerly produced gold, silver, lead, copper and zinc. It is located above timberline. There are three mills at Bonanza that could be placed in service to process ore if production is undertaken.

**The Colorado Public Health Dept. said 12 uranium mines in the state have been ordered to cease operations** in the past 10 months because of radioactive concentrations averaging 50 times above what is considered safe working level.

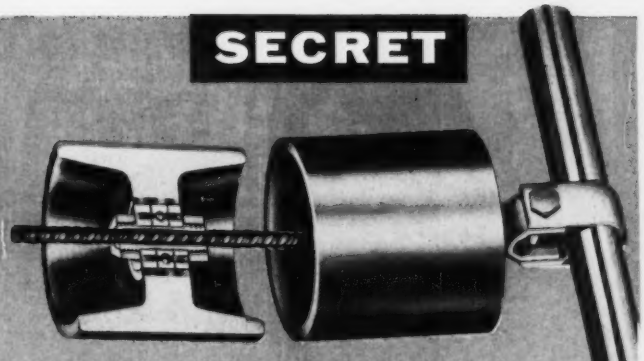
P. W. Jacoe, chief of the department's occupational health section, said about

# NEW CONVEYOR DESIGN

(EXCLUSIVE WITH McNALLY PITTSBURG)

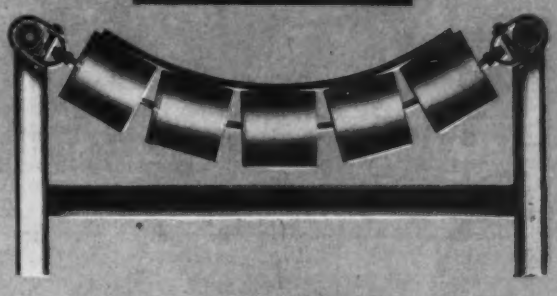
## ...means far longer belt life!
## ...slashes maintenance costs!

**SECRET**



. . . of the improved efficiency of this new belt conveyor. This new McNally Pittsburg Cradle Idler* consists of 5" rubber rollers assembled on precision ball bearings, prelubricated, lifetime sealed. Being a *true catenary* suspension with rollers mounted on flexible, *non-rotating*, stainless steel wire rope, this design eliminates "loping" and harmonics.

**RESULT**



. . . is greater capacity and faster belt operation with minimum spillage. Since the belt lies in true arc with no creases or bends to cause wear, *belt life is substantially increased*. Because this unique McNally Pittsburg conveyor design is so simple, maintenance costs are lower; over-all erection time is reduced to a minimum as well.

**For do-it-yourself construction,** the entire conveyor is shipped disassembled and may be put together in the field to fit your conveyor needs. Also, a new "SHORTY" conveyor is available, only 2 feet high, ideally suited for use in limited working areas, above or below ground.

**Write today** for full details and information on this new, remarkably efficient, McNally Pittsburg Conveyor. Its new design cuts installation costs—and saves you money on belts and maintenance.

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☐ Please send information on the new McNally Pittsburg Belt Conveyor.

☐ Have Sales Engineer call for further consultation.

NAME _____ TITLE _____

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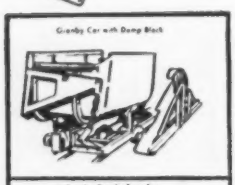
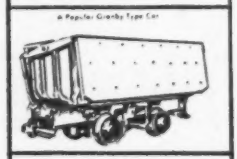
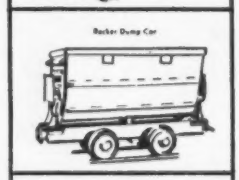
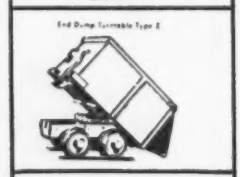
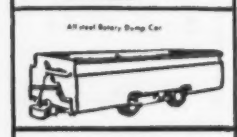
# FOR YOUR PRODUCTION HAULAGE Pick a winning Card!











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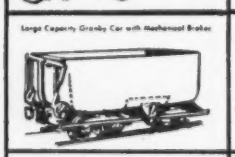

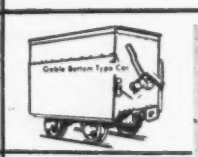

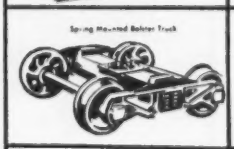

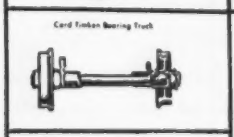

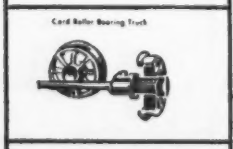

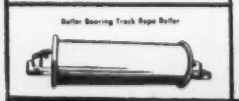

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## Colorado *(Continued)*

1,500 men are working in uranium mines where radioactive levels exceed permissible levels set by the state and AEC.

Jacoe said in most cases radiation levels above the permissible can be controlled through proper mine ventilation but some uranium mines cannot be ventilated economically.

## IDAHO

**A continuous five-unit zinc plant operation** and a somewhat less than six-day-per week lead smelter operation is contemplated for this year by the Bunker Hill Co. at Kellogg, employees were told in the company's annual report. "At this operational level, with continued rigid cost control and assuming continuation of current metal prices and demand, an improvement over 1959 operating results can be expected," Emmett G. Solomon of San Francisco, chief executive officer for Bunker Hill, told the workers.

Construction work on the new Bunker Hill phosphoric acid plant west of Kellogg is continuing on schedule and full production of the plant is scheduled for this summer, barring unforeseen difficulties. When in production, the plant will operate on a 24-hour, seven-day week schedule, company officials said. About 15 men will be required to operate the process due to the modern design and anticipated efficiency of the plant.

**L. J. Randall, president of the Lucky Friday Silver-Lead Mines Co. of Mullan, told stockholders** in Wallace that a bright future is indicated for silver and he said he could not help but feel optimistic as to the future of the Lucky Friday company because about 45% of the total gross value of its ore is in silver.

**Henry L. Day, president and manager of Day Mines Inc. of Wallace, reported to stockholders** the company's net income for 1959 was $1,234,252 compared with $694,846 in 1958 and he said "the year 1960 promises to be another financially satisfactory year for the company."

Day attributed successful operations in 1959 to the continued production of high grade gold-silver ore from the company's Gold Dollar property in Ferry County, Wash., and the firm's 25% participating interest in the operations of the Galena mine of the Callahan Mining Corp. near Wallace. Operations in the Wallace area have been largely limited to development work in the company's four principal mines, the Dayrock, Hercules, Monitor and Tamarack; and, he said, the company's 1960 plans call for a continuing extensive search for new properties in this area and elsewhere through a new Day Mines department organized for that purpose.

**Sunshine Consolidated Inc. noted in its annual report to stockholders that several development projects are scheduled** to get under way this summer in the Sun Con area of the silver belt west of Wallace. The 3,400-ft west drift is to be advanced to the westerly ore shoots, the 3,700-ft level is to be advanced to "ex-

NYGEN-BUILT

# GENERAL TIRES

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Projects that rip ordinary tires and schedules to shreds are naturals for extra rugged General Off-the-Road Tires. With stronger-than-steel Nygen cord construction and a deep-digging, high-flotation tread, Generals are built to take on rock, stumps, mud, sand without let-up or let-down. And that means more work done...more profit counted every day of the job! Be sure of both on your next project with General Off-the-Road Tires.

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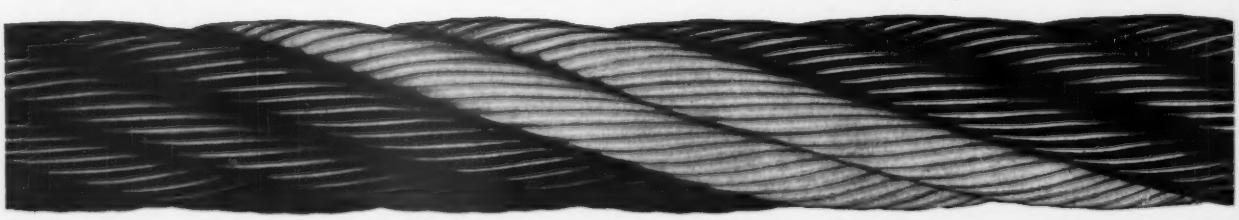
*Interim Progress Report on ...*

# DOUBLE GRAY-X®

## CF&I-Wickwire's new longer-lasting wire rope



# Falcon Seaboard Drilling Company field tests a prototype of Double Gray-X — now orders carload

The first company to use a prototype of Double Gray-X was the Falcon Seaboard Drilling Company of Tulsa. Aware that modern drilling practices demand the best possible equipment, Falcon Seaboard tested Double Gray-X on some of their rotary drilling rigs, an operation that subjects ropes to extreme abuse. Mr. Jack Starr, Vice President in Charge of Drilling, commented, "The results obtained from original tests with Double Gray-X prototype led to our decision to order *a carload of this improved product*. Falcon Seaboard insists on the best products, in order to serve the oil industry in accordance with today's modern standards."

### *The Secret of Longer Rope Life*

CF&I-Wickwire engineers, after intensive research, discovered that by using an entirely new wire drawing technique—including the use of Molysulfide* in the lubricant—the characteristics of the wire rope were greatly improved. This method creates a permanent molecular jacket around the individual wires that provides these benefits:

- **reduced friction between the individual wires in each strand of Double Gray-X during service**
- **minimized surface imperfections in the wires of Double Gray-X**
- **wires have greater resistance to abrasion, crushing and bending**

If you are a user of wire rope, you can *increase* the safety of your operation and *reduce* equipment downtime with Double Gray-X. Made in a wide variety of sizes and constructions, Double Gray-X is recommended for all types of equipment. For complete details on this new wire rope, call the nearest CF&I sales office or see your local distributor.

### *Greater Strength*

The molecular shield around this new premium wire rope gives Double Gray-X longer life. In addition, you get the *extra strength* for which Double Gray has always been famous. Made of extra improved plow steel with an Independent Wire Rope Core of the same material, this rope gives 15% higher breaking strength than the catalog breaking strength of an improved plow steel rope with IWRC.

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**WICKWIRE ROPE**

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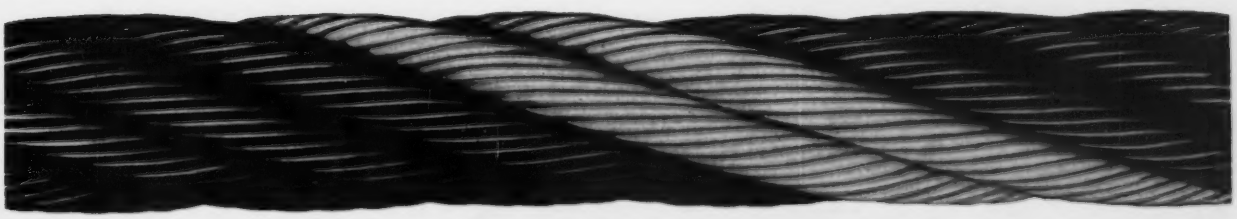
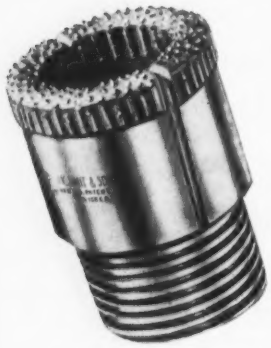


Only J.K.S. Can Give This Big Plus Value In

DIAMOND DRILL BITS



Newest and Best In Diamond Drill Bits For Every Drilling Need

Including: Surface set and impregnated coring bits—concave bits—pilot bits—thin wall coring bits—reaming shells—casing bits.

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Many of these men, and their fathers before them, have spent their lives with J. K. Smit as diamond experts. Theirs is one of the rarest skills in the world . . . a skill that makes a continuous contribution to the worldwide reputation of J.K.S. Diamond Drill Bits for giving more footage in every type of formation at lowest costs.

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## Idaho *(Continued)*

pected ore" west of the present 3,400 and 3,700 headings and "favorable structures" south of the Yankee Girl vein in the west end of the property on the 3,100-ft level will be probed by diamond drilling, W. M. Yeaman, company president, said. The one bright outlook for the future of the mining industry in northern Idaho is silver, Yeaman said.

**Sale of the Hornsilver Mining & Milling Co.** property south of Wallace to Day Mines, Inc. was completed at a meeting of Day Mines directors here. The sale was on a stock exchange basis.

**William Wilcox, president and manager of Salmon River Uranium Development Inc.,** says that mining activities will continue on the company's properties near Salmon. Extensive research and development work is planned to check the possibilities of the rare earth and thorite veins where tests have shown rare earths, lanthanum, praseodymium, neodymium, gadolinium, dysprosium and yttrium. The company owns and controls approximately 1,340 acres of mining property.

The company has leased its mill and equipment to Nuclear Fuels & Rare Metals of Pocatello. D. B. Lewis, Los Angeles, president, plans on up-grading ore from the properties in the Lemhi Pass area and also to install additional equipment in the Salmon River Uranium mill to further refine the product to thorium-oxide or to metal, at the Salmon Mill.

**Electro-Nuclear Metals of Roseville, Calif., will construct a $2-million zirconium-hafnium plant** in Lincoln County, according to an announcement from the Governor's office.

Pres. John R. Piches claims a new processing technique for separating the minerals from ores mined near Escalante, Utah.

## ILLINOIS-KENTUCKY

**A new and highly successful development in the shipment of fluorspar** for market dispersal in the Pittsburgh area was inaugurated recently by Minerva Co., fluorspar division of Minerva Oil Co. Concentrates of all grades now are being shipped in four-ply paper bags by Ohio River barge from the company's loading dock at Cave-in-Rock, Ill., to Wellsville, Ohio.

On delivery at Wellsville, the bagged product is stored in a warehouse, rented by the company, and held for dispersing by truck on a one-day service to purchasers in the Pittsburgh marketing area, according to O. E. Anderson, Minerva's Illinois plant manager. Substantial reduction in freight cost has resulted.

The bagged concentrates are loaded into 800 or 900-ton covered barges. As a striking venture in shipping procedure, it has attracted wide interest in the fluorspar mining district.

Production is from Minerva's mine No. 1 and its Crystal mine in the Cave-in-Rock section of Hardin County.

Minerva installed a crane, equipped

Model 35SL
*35 ton payload*

# REPEAT ORDERS *are Our Best Testimonials!*

**Since KW-DART placed its Model 35SL on the market two years ago, it has proved its excellent performance on job after rugged job. Its 24-cubic yard capacity (struck), its extreme maneuverability and durability assure the operator maximum operation at minimum cost. The 35SL, like *all* KW-DARTs, is tonnage engineered to stay on the job.**

**SINCE THEIR ORIGINAL FLEET ORDERS, 6 MAJOR COMPANIES HAVE RE-ORDERED FLEETS OF THE KW-DART 35SL...SEVERAL HAVE RE-ORDERED *TWICE!***

**Builders of heavy duty trucks since 1903**

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NEW VERSATILITY!

Mobile Drill's
B-40
"EXPLORER"

*real economy in a multi-purpose drill*

AUGERS TO 75 FEET

CORE DRILLS TO 500 FEET

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- Mounting flexibility—compact B-40 fits any carrier ½ ton or heavier.
- Has independent power plant—4-cyl. 36-hp air cooled engine. Also available without engine for mounting on PTO-equipped vehicles.
- Powerful hydraulic cylinder delivers 68" stroke with ram pressure of 7069 lbs. up and 6283 lbs. down—exceptional power in a lightweight rotary drill.
- Hydraulic rotary head drive is geared for positive drilling action. Drilling speed range of 50 to 600 rpm for either coring or augering. Maximum torque: 1740 lbs.
- Controls to hydraulic cylinder, clutch and throttle are conveniently grouped for safe one-man operation.
- Hollow spindle drive features exclusive Mobile chuck for quick connection of drill stem. To change from core to auger drilling, merely remove drill stem, attach universal drive coupling and insert auger sections.
- No clearance problems—drill frame and tower lower to horizontal travelling position only inches above carrier cab.
- Drill is easy to dismount so that vehicle need not be tied up permanently as a drill carrier.

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Dept. 33, 960 N. Pennsylvania St., Indianapolis 4, Indiana

George E. Gopher says:
"For a better return on your drilling investment, get Mobile Drill's B-40 Explorer"

## Illinois-Kentucky *(Continued)*

with a special lifting-fork designed to hoist 2-ton pallet loads of bagged fluorspar into the barge, at the dock site. Similar method is used in unloading the pallets at the Wellsville terminal. An average of one barge a month is required to keep the terminal warehouse stocked.

D. C. Spees of Rosiclare, Ill., former mill superintendent at the Crystal, is superintendent at the Wellsville terminal.

**Minerva Oil Co. resumed operation in May** at its Jefferson mine, which has been closed since September. Approximately 20 men were recalled to work. Plans also have been completed for sinking a new 425-ft shaft on the Fairburn property, adjoining the Jefferson property, for fluorspar production.

**Alcoa, fluorspar division at Rosiclare, Ill., announced transfer of two members** of its engineering staff to the Alcoa Exploration Co., raw materials division, at Ciudad Trujillo, Dominican Republic. Fred Wrobbel, in charge of Alcoa's power plant, and Walter Gammeter, in charge of underground mapping and surveying at the Rosiclare Works, were to leave for their new posts in June or July.

**Calvert City Chemical Co., wholly-owned subsidiary of Pennsalt Chemicals Corp., has announced election** of Albert E. Clement as president and LaMont West as vice president of the company. Both are also members of the board of directors. Calvert City Chemical, which produces acid grade fluorspar from its properties in Crittenden County, Ky., has been actively engaged in development of its reserves and in refining ore for use by Pennsalt in the Calvert City plant.

## MARYLAND

**Formal dedication of the new Kennecott Refining Corp. $30-million electrolytic refinery** took place May 19 south of Baltimore. (E&MJ, March 1960)

The refinery was welcomed to the state by Gov. J. Millard Tawes. Other speakers included Charles R. Cox, president of Kennecott Copper, and I. G. Pickering, project manager at the new refinery.

The plant is currently processing about 10,000 tons of high-purity copper per month from Chile and KCC mines in Arizona, Nevada, New Mexico and Utah. Design capacity is 16,500 tpm.

## MICHIGAN

**Interstate Commerce Commission has rejected protests** by Ashland interests that a lower rail rate on iron ore from the Gogebic range to Escanaba, Mich., would divert ore haulage away from the Gogebic Range to Ashland, Wisc. After holding back its approval when the reduced rate by the Chicago & North Western R.R. was first submitted, April 9, the

ASEA's new multi-rope friction mine hoists for installation in one of the largest mines take an unbalanced load of 55 tons at a speed of 2760 feet per minute—twice the load of any known hoist at this record speed.

Here are two major advantages of these new mine hoists pioneered by ASEA for mine owners everywhere.

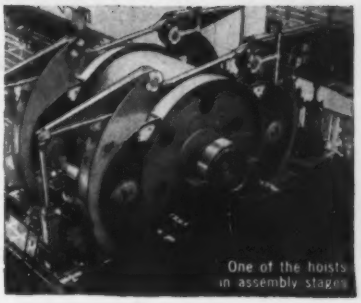
**1** MULTI-ROPE FRICTION DRIVE; this enables a moderate sized pulley (length, 7'2", diameter, 12'2") to take a very high unbalanced load with ease.

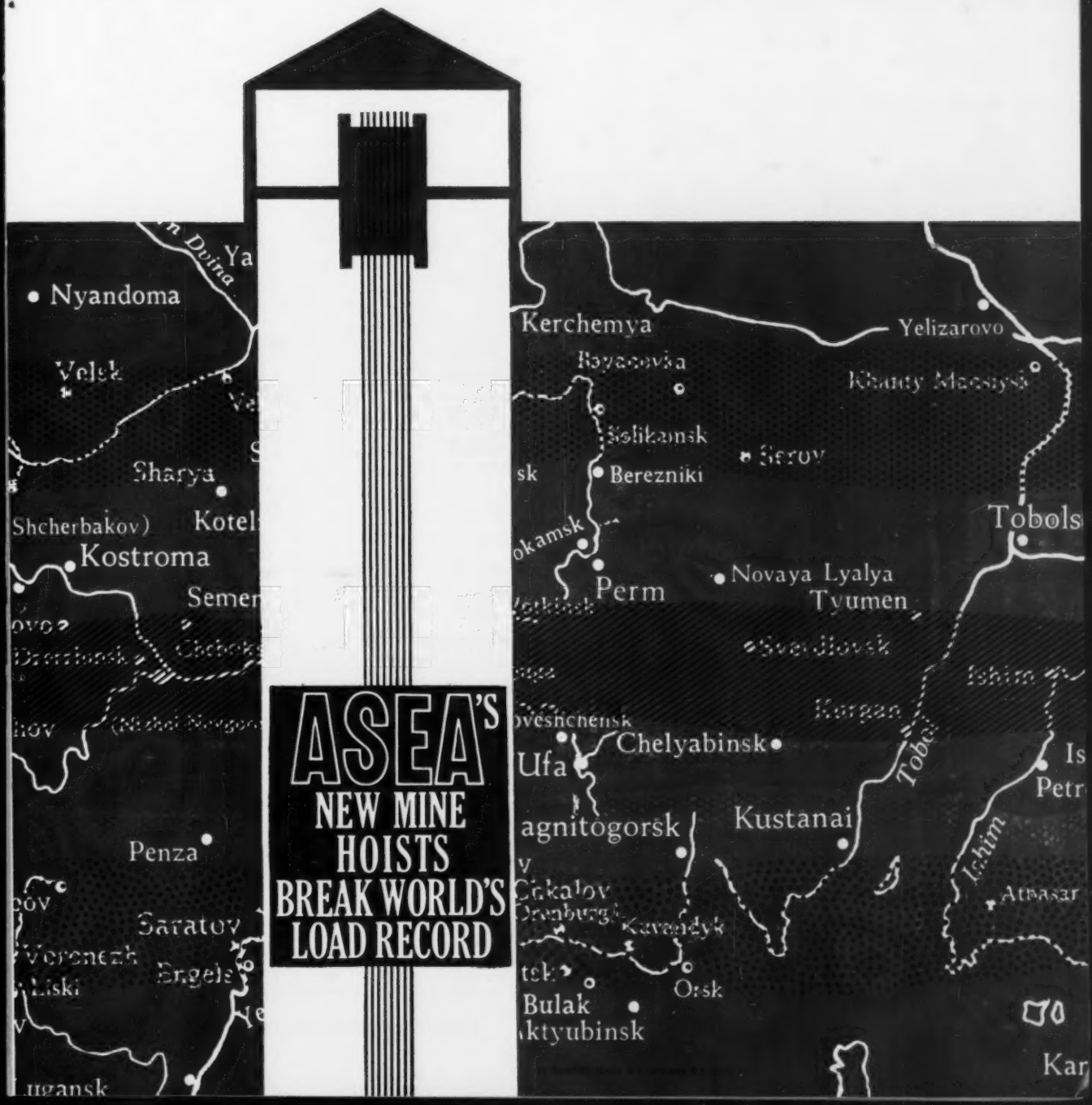
**2** FULLY AUTOMATIC OPERATION, which can save as much as $30,000 a year per hoist at prevailing U.S. wage rates, assuming two-shift operation.

Make profitable use of ASEA design and engineering experience. Let ASEA save operating costs—in a big way just as it saves for 14 U.S. and Canadian mining companies. Write for literature to: ASEA ELECTRIC INC. 500 Fifth Avenue, New York 36, New York and 55 New Montgomery Street, San Francisco 5, California.

TECHNICAL DATA

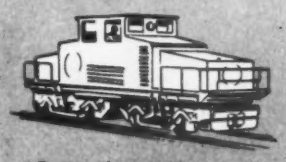
| | |
|---|---|
| Hoisting ..... Double Skip | Hoisting speed ..... 2760 ft. per min. |
| Hoisting capacity .. 1400 tons per hour | Number of ropes ..... 8 |
| Net load ..... 55 tons | Rope Diameter ..... 1¾" |
| Skip weight ..... 44 tons | Diameter of Pulley .... 12'2" |
| Depth of shaft ..... 3940 ft. | Length of Pulley ..... 7'2" |
| | Motor output .... 12,000 h.p. |


One of the hoists in assembly stages

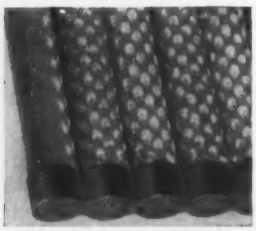


## NEW EXIDE-IRONCLAD LOCOMOTIVE BATTERIES

# pack up to 60% more power

| NEW TYPE BATTERY | CAPACITY PER POS. PLATE | APPLICATION | REPLACES BATTERY TYPE | PERCENT CAPACITY INCREASE |
|---|---|---|---|---|
| MG | 45 ah | Trammers | MVM<br>ML | 32.4<br>17.5 |
| RG | 55 ah | Mine locomotives | ML<br>TLM | 43.6<br>5.0 |
| TG | 72 ah | Shuttle cars | TLM<br>TH | 44.0<br>20.0 |
| TGS | 80 ah | | TLM<br>TH | 60.0<br>33.3 |
| TEG | 95 ah |  Battery locomotives | (new type—no prior data) | |
| MEG | 145 ah | | MEH<br>MEX | 45.0<br>21.0 |

**Boost the work capacity of your locomotives**



**THE SECRET.** New tubular construction packs more power in each positive plate . . . prolongs battery life.

These new, advanced Exide-Ironclad Batteries pack more power in the same space. They equip your present locomotives to do more work. And they actually cost less per ampere-hour, promise even longer life of service. Get complete information. Call your nearby Exide representative. Or write Exide Industrial Division, The Electric Storage Battery Company, Philadelphia 20, Pa.

Exide®


## Michigan *(Continued)*

new rate—$1.45 per ton, a reduction of $.55 per ton—became effective. CNR said the reduced rate is designed to help Gogebic Range mine operators to compete with foreign ores. Immediately following this, the Soo line announced a cut in ore haulage from the Gogebic range to Ashland from $1.25 to $.87, effective April 10. This reduction was proposed, and held up by the ICC, some time ago. It is believed that much, perhaps most, future ore from the Gogebic Range destined for the Chicago area will go by way of Escanaba because of the shorter lake haul and lower lake rate: $2 from Ashland to Chicago and $1.20 from Escanaba to Chicago. Ashland may still contest the reduction from the Gogebic to Escanaba.

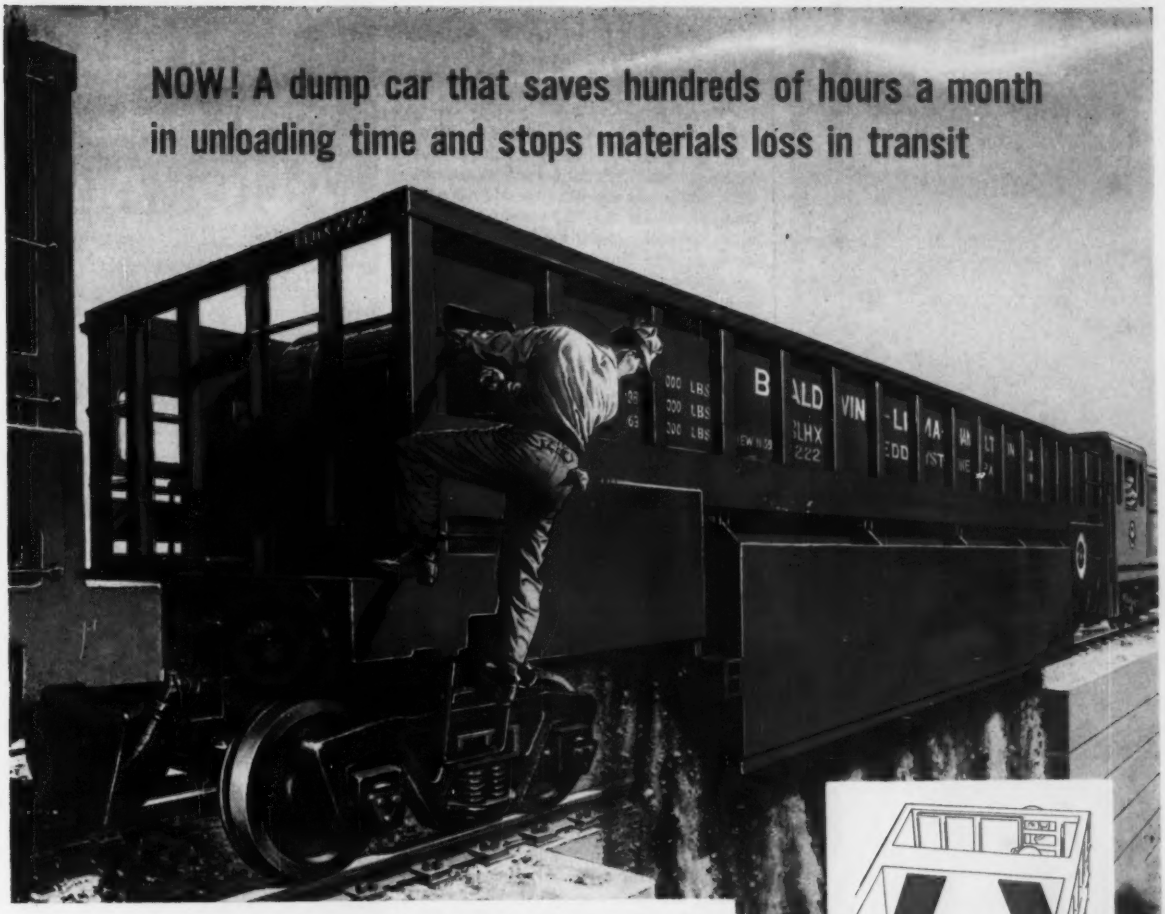
**After working a six-day week for the past year,** the Cannon, Homer and Hiawatha mines of the M.A. Hanna Co. have gone back to a five-day week. Output of the mines goes to the National Steel Corp. The Wauseca, also operated by the M.A. Hanna Co., remains on the six-day week. The Wauseca produces a good grade ore and can be sold on the open market. It is, therefore, not subject to the requirements of any one company. It employs about 200 men.

**At the April meeting of the Lake Superior Safety Council** held in Old Caspian April 7, James R. Tregear, Crystal Falls, safety inspector for Republic Steel Corp., was chairman of the arrangements committee. Warren Jamar, Iron River, discussed safety features of the friction type hoist now in use at the new Homer-Wauseca shaft in Iron River. Mr. Jamar is chief mechanical engineer for the M. A. Hanna Menominee Range mines. Bernard W. Carey, assistant superintendent at the Cary underground mine of the Odanah Iron Co., Hurley, Wisc., operated by Pickands Mather & Co., talked about local experiments with high expansion foam plug. F. G. Michaels, Ishpeming, safety director with North Range Mining Co., showed a film on mouth-to-mouth and mouth-to-mask resuscitation, produced by himself. R. N. Paull editor of THE HANNA MINER, gave his popular talk "Cave Man to Space Man" and T. W. Hill, Ishpeming, safety engineer with Cleveland Cliffs Iron Co., had as his subject "A Practical Approach to Mine Ventilation."

## MINNESOTA

**After having carried on winter stripping programs** at their Arcturus Mine at Taconite, the King and Plummer at Coleraine, the Sherman group near Chisholm, the Hull-Rust at Hibbing, the Pilotac taconite pit at Mt. Iron and the Rouchleau group at Virginia, the Stephens northeast of Aurora and the Gilbert at Gilbert, in addition to the usual overhauling of mine equipment and plants, the Oliver Iron Mining Div. is prepared for a busy ore season. The division's 1960 shipments will come from operations on the Mesabi and Vermilion

# NOW! A dump car that saves hundreds of hours a month in unloading time and stops materials loss in transit

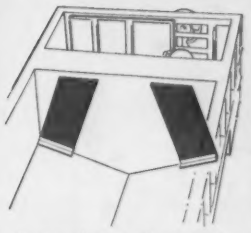


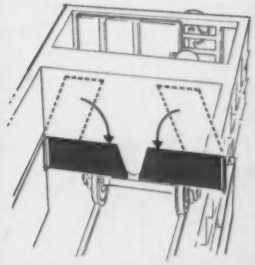
Designed to dump straight down into a receiving bin or hopper, B-L-H's new and highly efficient bottom dump gondola virtually does away with the two bugaboos that have long plagued copper-concentrate producers and other processors of ore and chemicals—time-consuming unloading operations; and ore losses in transit.

**Note these major features of the car:**

- Sides slope slightly outward at the bottom, to overcome any tendency of the materials to stick to the walls
- Special low-adherence paint further counteracts sticking
- Steel blade device extends up into body of car, acts as scraper along endplates; blade device is optional—need for it depending on characteristics of material to be dumped
- One movement of a single lever dumps payload clean and fast
- Rubber seals fastened to inside of door plates and running along three sides of each door prevent liquids from leaking out

B-L-H's new ore-carrying dump car can be built to your individual specifications in any capacity you require. For complete details, write requesting Bulletin 3001.





In dumping, as doors swing down and out, knife blades welded to doors cleave mineral deposits from ends of car in one fast, clean sweep.

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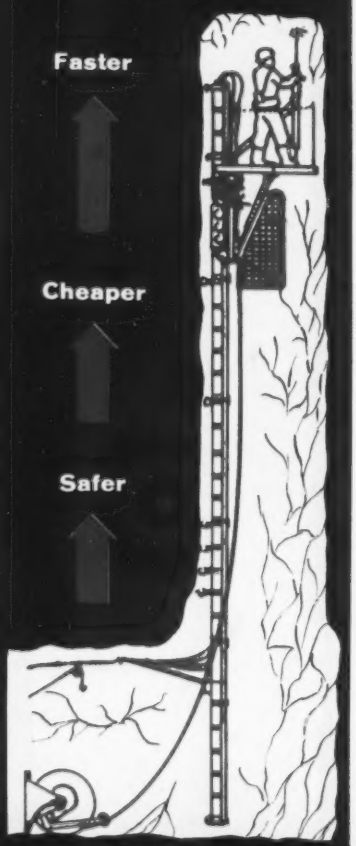
UP with ALIMAK
Raise-Climber
Driving raises from 40 feet up to 1200 feet or more




The Climber lifts the operator to the working face. After drilling and loading, the unit lowers the operator and folds back for blasting. A ventilation system is incorporated through pipes in the guide rails.

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IN DENVER SINCE 1891
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## Minnesota *(Continued)*

Ranges. The two Vermilion operating mines are the Pioneer and Soudan, both underground properties. The Mesabi Range mines are all open pits.

**Robert J. Linney, executive vice president of Reserve Mining Co., said on April 6 that preliminary engineering work had begun on plans for almost doubling the Silver Bay taconite plant's capacity** to about 9-million tons of pellets per year. The plans, he said, include the construction of a new fine crushing, concentrating, pelletizing, railroad and power facilities. Reserve's entire output goes to its joint owners: Republic Steel Corp. and Armco Steel Corp. Its supply of crude taconite comes from lands, in the Babbitt area, leased from Mesabi Iron Co. After eight years of litigation and arbitration over accounting methods by which to arrive at Mesabi Iron Co.'s one-third of Reserve's net profits as their royalty, directors of both companies agreed on a settlement. It provides for a straight royalty of up to $1 per ton of pellets shipped. The agreement includes a clause which offers lower royalty figures as an incentive for Reserve expansion. In a letter to Reserve employees Linney said: "Reserve has recently signed an agreement with Mesabi Iron Co. which provides for the settlement of all the difficulties. . . . It is now possible for Reserve to develop plans for expanding its capacity."

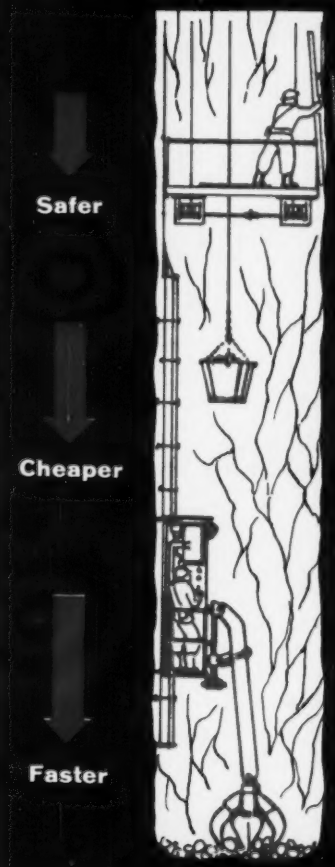
Reserve expects to begin the program as soon as possible. He estimated that the new facilities could be in operation about two years after work began. Mesabi Iron Co. stockholders approved the agreement at a special meeting held on April 22. Linney added that Republic and Armco have been pleased with the cooperative attitude toward Reserve's taconite operations by state officials, the Minnesota legislature and the local communities in which the company operates.

**The fourth annual meeting of the mining sub-section of the Minnesota branch of AIME** was held in Chisholm, April 13. The speaker was Ed Surrett, assistant district manager of the Du Pont Explosive Div. in Duluth. He talked about "Unique Blasting Problems" and showed a colored film on the "Ripple Rock Project" and another on the demolition of buildings by explosives.

**The first car load of iron ore from M.A. Hanna Co.'s Pierce Mine in North Hibbing was loaded** April 7. Stripping began at the property in August 1957 and still continues. Since that date about 6½-million cu yd of surface and rock have been removed. Most of the surface material was carried to a dump three miles from the mine by belt conveyor. The new plant at the Pierce has crushing, screening, heavy media, cyclone and spiral equipment. First train of ore from the mine left April 14. It expects to ship over 1-million tons this season.

**Bethlehem Steel Corp.'s 730-ft long by 75-ft wide new ore boat,** the 25,000-ton capacity "Arthur B. Homer," on her first trip up the Great Lakes, took on a cargo of pellets from Erie Mining Co. at

DOWN with ALIMAK
Shaft-Mucker
"ALIGRAB"
Sinking system for mucking shafts to any depth




Because of unusual features of "ALIGRAB", air and water lines are eliminated. They are built in the guide rails. Timber not needed to hold unit. Shaft timbering can be installed from finger-tip controlled "hang scaffold". Surface hoistman unnecessary.

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Taconite Harbor. The Homer and the Canadian freighter, "Murray Bay" of Canada Steamship Lines, are the largest on the Great Lakes. The "Edward L. Ryerson" of the Inland Steel Co. fleet, also 730-ft long, will be launched later in 1960.

**The 1959 annual report of Oliver Stark, Crow Wing County** (which includes the Cuyuna Range) mine inspector, shows a total of 1,217,961 tons of ore and 4,092,521 cu yd of stripping moved during the year. Hanna Mining Co. and the Hanna Iron Co. shipped from eight mines; Pickands Mather & Co. from two producers and one stockpile; Inland Steel Co. from the Armour No. 1 and No. 2 underground mines; and Pittsburgh Pacific Co. from five properties. Some 870 men were employed at the 17 operating mines. There have been no fatal accidents at Crow Wing County mines during the last five years.

**Pickands Mather & Co.'s Albany Mine in Hibbing was closed in May 1958** because the mining costs were too high to produce a commercial ore. During the past winter, a small crew of men has been occupied in repair work in the mine and the installation of new equipment. At present, with a total of about 25 men, the mine is being worked, experimentally, with three pieces of special equipment: (1) a jumbo drill rig mounted on a small tractor; (2) a timbering machine, also hydraulically operated; (3) a shuttle car which carries the ore from the working face to a conveyor to carry the ore from the mine. Another conveyor lifts it to the surface. The shuttle car is filled by a mechanical loader. This car has been used in coal mining, but is new in iron ore mines. The experimental project has the cooperation of the union and the fee owners. The company is anxious to mine out this single level orebody and hopes that the new equipment will reduce costs sufficiently to permit it. The Albany is one of the older mines in the Hibbing area. It was opened in 1903 by the Crete Mining Co. (PM&Co. as operators) as an underground mine. It has been worked, with some interruptions, since that time and as an open pit for much of the time. The remaining ore must be mined underground from the pit banks. The shaft has been dug out for some time. The Albany has produced a total of 15,601,693 tons up to this season.

## NEVADA

**Mineral Materials Co. ceased its iron mining operations in Pershing County's Mineral Basin area** during April, throwing 29 men out of work. The action followed negotiations weeks previously when U. S. Steel Co. bought the Mineral Materials mill in Mineral Basin and took an option on the firm's iron ore claims. Mineral Materials Co. retained the right to continue mining and milling operations pending U. S. Steel's decision regarding the option, but the firm's officials decided to shut down production and await the outcome.

**The New York mine near Virginia City, one of the big producers of Bonanza Days, is again in operation,** and four men are mining gold ore under supervision of Don Jardine, who is also leaser of the property. In April the hoisting motor burned out and the four miners each climbed by ladder from the 800-ft level to the surface. The last of the four reached the top just 15 minutes before the motor was repaired. The New York shaft goes down 1,200 ft, which qualifies it as Nevada's deepest operating gold mine.

**Allied Atomic Corp., of Imperial Beach, Calif., has bought 100 acres of** perlite claims in Pershing County from Mrs. Mazie Chester, of Lovelock, for $15,000. C. C. Warner is president of Allied Atomic Corp. and the company's engineer is Jerry Hoffman who for 20 years was with the Arizona Bureau of Mines. The perlite in the area is reported to be of good grade, usable for heavy construction work. A spokesman for the company says plans call for immediate development of the area, which lies 40 miles north of Lovelock and just south of the Black Rock desert.

**Floyd and Keith Kuykendall shipped their first load of gold-silver ore** from their Green-Gold mine in Pershing County during April. The shipment went to the smelter at Selby, Calif. The mining property is situated on the western side of the East Humboldt range, and the Kuykendall brothers have been developing it for the last several months.

**Eagle-Picher Co. has developed a new open pit of filterable grade diatomaceous earth** in its Trinity Mountain holdings 20 miles west of Lovelock. The new pit will supplement the output from the firm's Mine No. 1 a few miles distant, which supplies material for Eagle Picher's mill at Colado, six miles east of Lovelock in Pershing County. John Pedro, local machinery contractor has been given a contract to stockpile 70,000 yards of material at the new pit and also to remove overburden. The new development covers an area of 15 acres.

Production from Mine No. 1 continues steadily. Large shovels stockpile the material which is loaded onto specially designed trucks for transport to the mill. Wells Cargo Co. has the hauling contract. The Eagle-Picher mill, which during early months of its operation was on a part-time basis, is now working six days a week.

**Nevada Clay Products Co., of Hawthorne, reports that nine drill holes made in their property** in the north end of Fish Lake Valley in Esmeralda County indicate the deposit of several million tons of good grade bentonite. Deposit averages are better than 60 ft in thickness and there is little overburden. Carl Ganschow is general manager of the operation.

**White Caps Gold Mining Co. at Manhattan in Nye County reports that the 1,200 ft level has been reached** in the White Caps mine and that a core drilling program will be put into operation to explore a known body of ore that

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Man, materials and or hoisting for small mines
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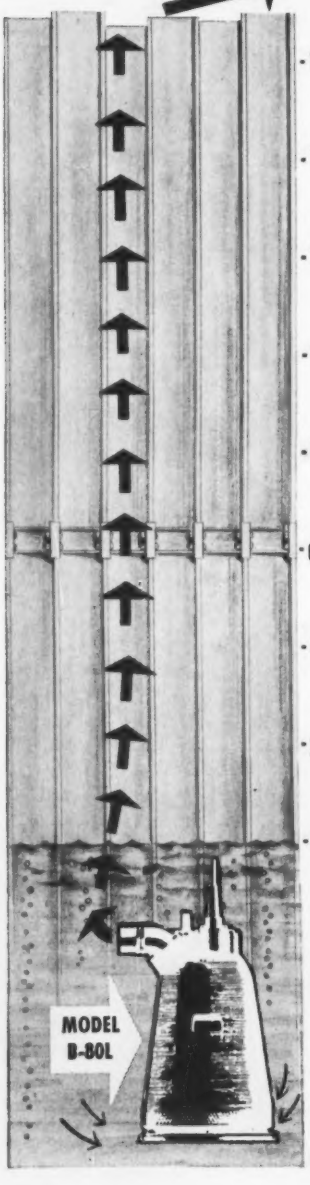
## ELECTRIC SUBMERSIBLE PUMPS

170 FOOT HEAD • HIGHER IN TANDEM




One drainage job. One 3" Flygt pump. Put them together and you've got action — 340 GPM at discharge; heads to 170 feet or higher in tandem. This is typical performance from Flygt — the only pump that can cut your pumping costs — handle your drainage and dewatering jobs in less time. All other models in the Flygt line, ranging in discharge sizes from 1½" to 8", and capacities to 3100 GPM with heads to 220 ft., give comparable excellent performances. Flygt electric submersible pumps are solving difficult water problems on thousands of jobs all over the world. Fully portable, they go right in the water — start pumping immediately, giving day and night performance without supervision and only occasional inspection. Rugged, simple, fool-proof, economical — Flygt pumps are the modern approach to drainage and dewatering. Get to know Flygt by writing for illustrated brochure, then ask your local distributor for an on-the-job demonstration.

FLYGT Corporation

HOOSICK FALLS, N. Y.

WESTERN SALES & SERVICE: STANCO MFGS. & SALES INC., 1666 Ninth St. (Corner of Olympic) Santa Monica, Calif.

PUMP BETTER ELECTRICALLY—USE FLYGT!


## Nevada *(Continued)*

exists between the 1,200-ft and the 1,300-ft levels. H. F. Cameron is superintendent of the operation.

**Belmont Mine Co. has temporarily shut down its El Dorado South shaft,** according to Walter Simmons, general manager. The action was taken following recommendations by R. O. Comozzi, engineer and geologist, who said that a core drilling program will be initiated from the surface in the near future to explore the orebodies before any further underground operation is attempted. During the previous several months 14 men had been employed, working in two shifts, and had made extensive progress in restoring timbering and reopening the old tunnels and shafts under direction of Jack Tilman, foreman. The property is situated at Belmont, former seat of Nye County, 60 miles north of Tonopah.

**Calumet & Hecla Mining Co. and U.S. Milling & Minerals Corp. have signed a contract** for joint development of the Tonopah King mine near the Nye County seat. As part of the accelerated program a shallow incline has been sunk from the 550-ft level and ore 18 to 20 ft wide has been found at the termination point. Plans call for sinking the present winze from the 550-ft level to the 750-ft level as well as for some 100 ft of drifts and crosscuts to open up the orebody and establish its continuity. Ore from the Tonopah King is sent to the USM&M mill at Silver Peak for upgrading and smelting.

**Organization of Ruby Hill Mining Co. by major metal firms for what could include a $10-million search** for lead-silver-zinc ores in Nevada's historic Eureka District has been effected at Salt Lake City.

The program results from an agreement between Eureka Corp. Ltd., Toronto, Canada, and Richmond-Eureka Mining Co., Salt Lake City and Boston, to resolve a legal dispute in Nevada courts.

Richmond-Eureka is largely controlled by United States Smelting Refining & Mining Co.

Stockholders of Richmond and Eureka Corp. Ltd. at a May meeting approved, and the properties in the Eureka district along Ruby Hill will be transferred to the new Ruby Hill Mining Co.

This company in first phase of operations would be controlled 75% by Richmond-Eureka Mining Co. and 25% by Eureka Corp. Ltd. The latter firm pioneered explorations at the Fad shaft in the district after World War II.

Other participants in Ruby Hill will include Cyprus Mines Corp. and Newmont Mining Corp. Hecla Mining Co. also has the opportunity of purchasing a portion of the interests accruing to Eureka Corp.

Cyprus, Newmont, Eureka Corp. and Richmond-Eureka each will kick in $250,000 for a total of $1-million in the initial exploration program at Ruby Hill, Nev.

Series of two options shows $9-million could be made available for exploration, development and mining in the poten-

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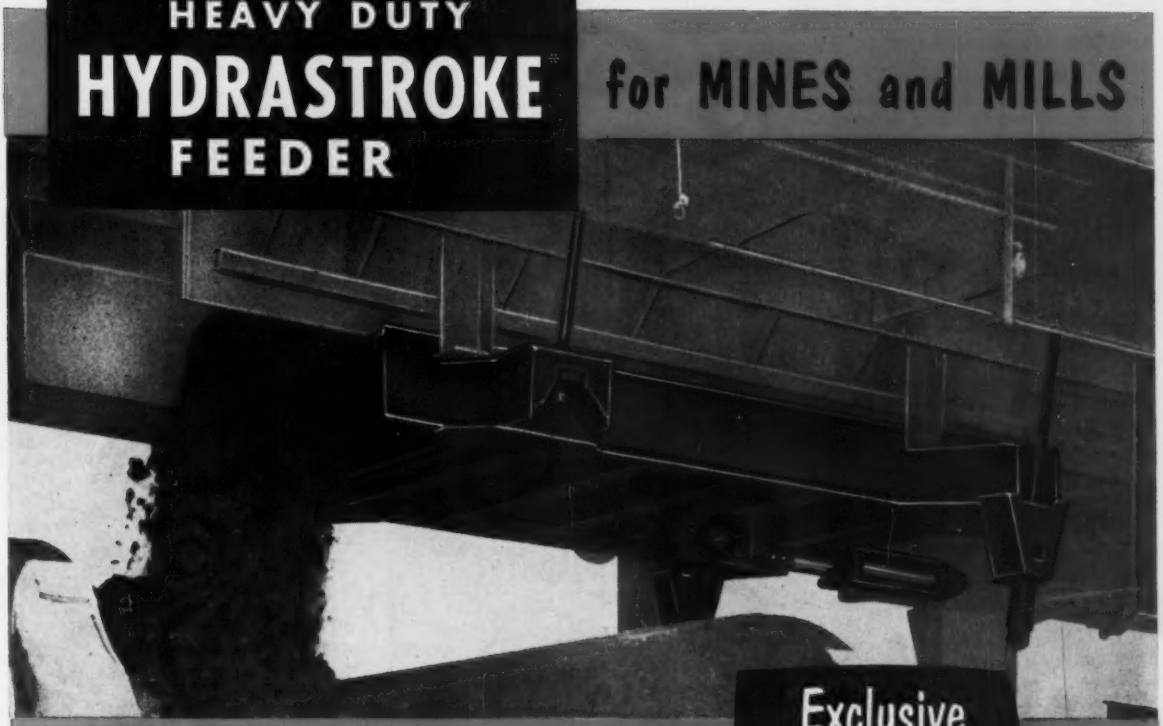

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*Modern equipment such as this power-operated positioner handles large parts, cuts effort, speeds hard-facing.*

*30 year welding veteran prefers semi-automatic welder as less fatiguing, faster and easier. He's hard-facing slusher blades with Stoody 100 in this picture.*

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In one of the country's major gold mines it was once common after short service to find half of a 900-pound slusher actually worn away. But not today!

Slushers are now hard-faced, as shown, with Stoody 100 applied by the semi-automatic welding machine. A power-operated positioner allows the work to be turned for easy, fast, downhand welding of all wearing areas. This hard-facing procedure triples or quadruples the service life of the equipment.

The speed and efficiency of the semi-automatic method save two-thirds of manual welding time, get more hard-facing done, do it better, cut costs. An example: Skip car wheels were formerly rebuilt manually in four hours; the semi-automatic machine and rotating positioner, using Stoody 107, get a better job done in twelve minutes...with deposits so smooth that machining is unnecessary.

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**Tennessee** *(Continued)*

metallic industrial minerals, coal-lignite, and uranium for long-range industrial

**at Cane Creek, south of Moab, would probably not hit the market until 1963.**

## Nevada *(Continued)*

tially large silver-lead-zinc deposit on the Ruby Hill.

In Salt Lake City for development of details of the agreement were F. S. Mulock, president of U.S. Smelting; Fred Searls, Newmont vice president, and Neil O'Donnel, president of Eureka Corp. Oscar A. Glaeser, vice president of United States Smelting & Refining Co.'s western operations, is general manager of Richmond-Eureka.

Officers of the newly-formed Ruby Hill Mining Co. have as yet not been named.

## MISSOURI

**Granite City Steel Co. and American Zinc, Lead & Smelting Co., in a joint venture,** completed seven deep diamond drill holes at the Boss-Bixby and Bourbon iron prospects. At Boss-Bixby, a commercial thickness of both iron and copper ore is indicated. At Bourbon, the drilling has found a sizable deposit of magnetite that can be easily concentrated.

Both tracts will require further drilling before a program for mill construction and other facilities can be laid out.

## NEW MEXICO

**A joint exploration program between American Zinc, Lead and Smelting Co. and Hydrometals, Inc.,** has found considerable 10% zinc ore near the latter's Peru mine. It is expected the ore will produce 51 to 53% concentrates. If underground development confirms the drilling, the property should be in production late in 1960. All concentrates will be shipped to American Zinc's Dumas, Tex., smelter.

## SOUTH CAROLINA

**The Larriar Gold Mine** in Kearshaw County is being reopened by Kearshaw Mining Co., after having been closed since the 1880's. Marshall Haney, consulting mining engineer who recently examined the property notes that the old tailings dump runs as high as $17 to the ton.

## TENNESSEE

**American Zinc, Lead and Smelting Company now owns ore reserves in Tennessee with a gross value of about $400-million.** These reserves are expected to last at least 50 years at a rate of production of 100,000 tons of zinc concentrates annually. This rate of production will be reached after a planned expansion of American Zinc's Mascot mill from 1,227,000 tons of ore a year to 1.6-million tons.

**The new East Fork mine, near Del Rio, Cocke County,** is producing over 50 tpd of high grade barite ore from a 6-ft wide vein. The East Fork mine is, at present, the only active barite producer in the district.

Almost all barite in the Del Rio district occurs in the Snowbird sandstone formation of pre-Cambrian age. The barite is usually in steeply dipping veins or, sometimes, a replacement along low angle thrust faults.

**American Zinc Co. of Tennessee, a subsidiary of American Zinc, Lead and Smelting Co.,** has proven 1-million tons of lead-free zinc ore in the vicinity of their new Immel shaft, located near Straw Plains. The shaft, which will be circular, is expected to be 1500 ft deep. American Zinc now ranks a close third among the largest zinc producers in the U.S.

**New Jersey Zinc Co. plans to develop another mine** in the Copper Ridge zinc district of East Tennessee. The new mine will be developed with an incline large enough to handle mechanized equipment. New Jersey Zinc already operates the Treadway mine in the same district. Production at this mine is being increased from 1,000 to 2,000 tpd.

All ore so far discovered in East Tennessee's new zinc district occurs in

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**COPPUS BLOWERS**

## Tennessee *(Continued)*

the Kingsport limestone formation of the Knox dolomite.

## TEXAS

**The Corpus Christi Chamber of Commerce has made a grant of $5,250 plus a gift of special testing equipment** to the Bureau of Economic Geology of The University of Texas to make a mineral resource survey of 35 counties in south Texas. Part of a general economic industrial survey, the aim of the study is to make an up-to-date inventory of nonmetallic industrial minerals, coal-lignite, and uranium for long-range industrial planning. The area of interest extends from the Gulf of Mexico to Del Rio, Texas, and from the Rio Grande to central Texas. Of particular interest are clays, pumice and pumicite, industrial sands, coal and lignite, aggregates, and uranium. The project is under the direction of Dr. Ross A. Maxwell.

## UTAH

**Production from the multimillion dollar Texas Gulf Sulphur Co.'s potash venture at Cane Creek, south of Moab, would probably not hit the market until 1963.**

Texas Gulf and Delhi-Taylor have announced agreement whereby Texas Gulf would build a mine and refinery and market the potash. Delhi-Taylor would receive a 25% net profits interest (carried).

Texas Gulf chairman F. M. Nelson, Houston, Tex., already has announced that the project would make money for the big sulphur producer while the payments were being made to Delhi-Taylor.

It is Texas Gulf's first venture into potash.

As originally projected by Delhi-Taylor, the Cane Creek reserve in the Canyon of the Colorado River, has sufficient potash to permit 1,000 tpd production for 41 years. This estimate is two years old, however. Since then, Delhi-Taylor has validated added reserves in this area. And to the south, Superior Oil Co. of California, has delineated other reserves. While these aren't committed to Texas Gulf, an earlier reserve drilled at Seven Mile Anticline northwest of Moab is a part of the package deal between the two firms.

Some observers credit the area with more potash than originally known in the Carlsbad, N.M., district. Neither Delhi-Taylor nor Texas Gulf will comment on reserves.

In past two years, Delhi-Taylor has been successful in obtaining the Carlsbad railroad rate to midwest and other market areas of the United States.

The firm has conducted close negotiations with the Denver & Rio Grande Railroad Co. on construction of a line some 50-60 miles south of Green River to Bartlett Mesa, over-looking the Cane Creek reserve.

Both the potash refinery and mine adit would be on the west side of the Colorado directly below Bartlett Mesa.

As originally conceived, a 2,300-ft, concrete-lined, circular shaft would be sunk to the potash beds at Cane Creek.

Under the Delhi-Taylor-Texas Gulf agreement, the latter firm will have until Jan. 1, 1961, to complete an examination of these technical aspects. The firms said that " . . . it is assumed that commercial developments will begin upon completion of this work." Significantly, timing of the entrance of Texas Gulf potash on the national market coincides with the end of the "tax-free" period for some of the new producers in the Saskatchewan district where high shaft sinking costs and mining problems have plagued some.

As an incentive to development, operators in the Canadian fields were given tax benefits for five years by both Provincial and National Canadian governments.

Estimated cost of the Cane Creek potash complex is placed at more than $20-million. Some 300 would be employed in mine and mill.

**The Atomic Energy Commission has announced a new try at selling a portion of its hoard of vanadium (red flake) (V205)** stored in the compound at Grand Junction, Colo.

The vanadium was acquired as a part

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## Utah *(Continued)*

At a coal stripping operation in Pennsylvania, this TC-12 removes overburden at a rate of 400 to 500 yds. per hour. It is equipped with 16' blade...works two 8 hr. shifts a day.

Euclid Twin-Power teams — TC-12 Crawlers and TS-24 Scrapers — move over a million yds. a month at this Wyoming open pit uranium operation.

Model C-6 crawler back-filling overburden in the pit . . . full-power shift, good visibility and fast response make this "Euc" a high production machine for mine and quarry work.

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Euclid's modern crawlers—the 211 net h.p. Model C-6 and the Twin-Power Model TC-12 with 425 total net h.p.—have set new standards of tractor production in mine and quarry work. With performance proved Torqmatic Drive, both of these crawlers have excellent maneuverability and fast response that cuts work cycle time. They're engineered for easy service accessibility that results in less downtime and lost production.

Have your dealer give you all the facts on these "Euc" tractors...he'll show you the features that pay off in better production on every stripping job, whether it's heavy dozing or ripping work, push loading big scrapers, or moving coal, ore and other materials.

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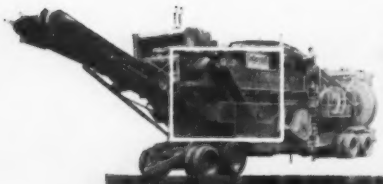

Cedarapids Super Commander Portable Crushing and Screening Plant, built by Iowa Manufacturing Company, Cedar Rapids, Iowa, produces up to 500 tons of material per hour.

**This high capacity V-Belt Drive handles 60% more power in 30% less space!**

***Gates Super HC V-Belts solve product-development problem!***

Iowa Manufacturing Company was faced with a problem: Transmitting 400 hp from a higher-speed engine in a space that had been just enough for conventional V-belts carrying 250 hp.

At higher speeds, centrifugal force made larger sheave diameters impossible. A wider span of belts was ruled out by Highway Department restrictions of overall machine width to eight feet.

Iowa Manufacturing's designers solved their primary problem of transmitting 60% more horsepower with new Gates Super HC V-Belts.

Because Super HC V-Belts have smaller cross section, use narrower and lighter weight sheaves, designers also succeeded in reducing drive weight, width and height—a decided bonus in portable equipment.

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A Gates Distributor can show you how sheave diameters can be reduced 30% to 50%, drive space up to 50%, and drive weight 20% or even more with Super HC V-Belt Drives. Ask him for your free copy of *"The Modern Way to Design Multiple V-Belt Drives"*, or write to The Gates Rubber Company Sales Division, Inc., Denver, Colorado.

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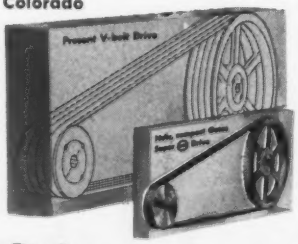



Gates
*World's Largest Maker of V-Belts*

**Gates Super HC V-Belt Drives** same hp capacity in smaller "package"

## Utah *(Continued)*

of the price support program for development of uranium concentrates from the Colorado Plateau.

A previous bidding two years ago failed to elicit the kind of prices AEC could accept. With recent strengthening of V205 prices, AEC announced it would receive bids May 23 at 10 a.m. at Grand Junction Operations Office for sale of some 1.5-million lb of the material.

**North Lily Mining Co. has expressed hope that explorations by Bear Creek Mining Co. in Utah's Tintic district will be productive enough** to warrant the firm launching a like program.

North Lily management made the disclosure at annual stockholders meeting. during which a shareholder asked about dividend policy.

Management said that it preferred to place funds into exploration, explaining that total income in form of dividends from Deagon Consolidated Mining Co., owner of a halloysite clay deposit in the district, had declined from $35,918 last year to $37,020 this year. North Lily has total cash of $149,916 on hand.

North Lily controls Dragon and is itself controlled by an affiliate of Anaconda Co. Bear Creeek is wholly-owned domestic exploration subsidiary of Kennecott Copper Corp. It has made significant discoveries of high grade lead-silver-zinc ores in the Tintic District, where it is operator of a unit program.

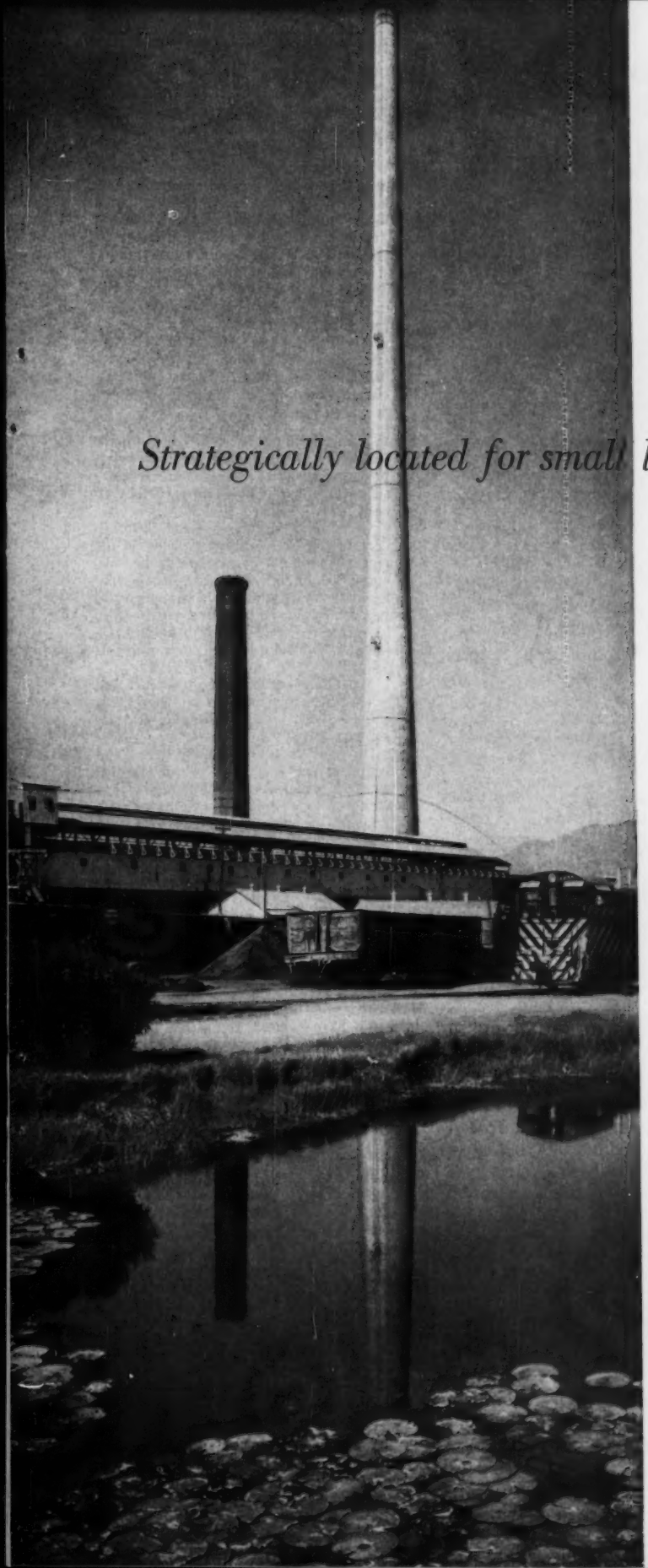
**Minerals Engineering Co. has design and engineering underway on a plant at Salt Lake City to recover high purity vanadium** from ferro-phosphorus, a by-product of elemental phosphorus furnaces in the west.

Blair Burwell, Sr., Grand Junction, Colo., president of Minerals, said his firm would produce up to 2-million lb annuall yof 98-99% $V_2O_5$ from an "intermediate product" obtained from Food Machinery & Chemical Corp. furnaces at Pocatello, Ida.

He said FMCC would produce a slag containing more than 10% $V_2O_5$ from ferro-phosphorus tapped from the elemental furnaces at Pocatello, Ida. Mr. Burwell said this was the first attempt in U.S. to produce high purity vanadium from the phosphatic ores found in Utah, Wyoming, Idaho and Montana. There are literally hundreds of millions of tons of the phosphatic deposits in Phosporia formations of the Intermountain Area. The $V_2O_5$ content of these ores run as high as plus 1%, compared with average grade of 1¼% $V_2O_5$ now mined on Colorado Plateau of western Colorado and southeastern Utah.

The Minerals plant will be built adjacent to that firm's subsidiary Salt Lake Tungsten Co. plant on Salt Lake's west side, Mr. Burwell said. He declined to estimate cost or to detail metallurgy, but said funds for the plant would be generated from "internal sources" by Minerals.

Generally, Mr. Burwell said, process will involve heat chemistry. This is interpreted to involve a type of high pressure, high temperature, high corrosive interaction in autoclaves.



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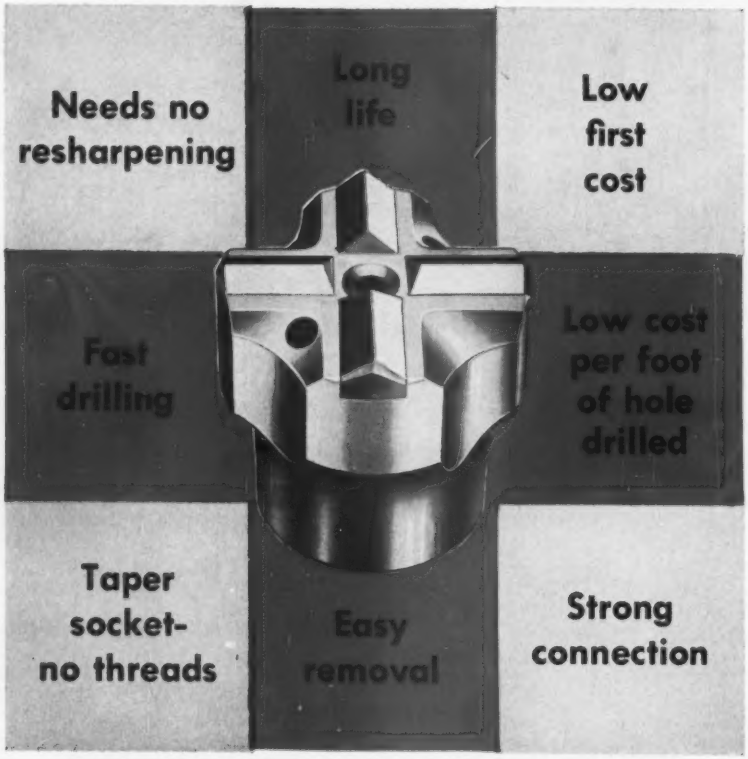


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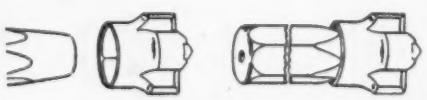
The exclusive, shallow, long-life inserts of the TEE CEE BIT need no resharpening. LIDDICOAT design precludes the reverse taper dullness common to conventional bits and gives TEE CEE BITS a fast and effective drilling life lasting far beyond the point where conventional bits must be withdrawn from service for sharpening.

The bodies for LIDDICOAT Bits are forged from nickel alloy steel. The tremendous pressure which extrudes the desired shape retains the important grain of the steel . . . flow lines being compressed rather than cut across as is usual in forgings of this type. The compression of the material and retention of the unbroken flow lines give LIDDICOAT Bits unusually strong structure.



**Western Rock Bit Manufacturing Co.**

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## Utah *(Continued)*

FMCC will produce an "intermediate product" from the ferro-phosphorus.

Mr. Burwell estimates that several million tons of ferro-phosphorus are available to his process from elemental furnaces in the Intermountain Area. While some ferro-phosphorus is sold in "tapped state" from furnaces, demand is limited in fertilizer or chemicals trade as it competes with compounds made from elemental phosphorus.

As a result, ferro-phosphorus "slag" is piling up at furnaces.

The FMCC intermediate product also contains minor chrome, but Mr. Burwell said chrome recovery is not presently contemplated in the Minerals' program at Salt Lake City.

**Failure of Congress and the Administration to effect a long range minerals program has made the mining industry skeptical of politicians and political parties.**

Oscar A. Glaeser, speaking as president of the Utah Mining Assn., told the recent 5th annual symposium of the Uranium Section of AIME, at Moab, that the industry would "react with vigorous support to the persons and parties who recognize its needs and who work for a realistic and helpful long-range minerals policy."

Mr. Glaeser also is vice president and general manager of western operations, United States Smelting Refining & Mining Co.

He said that western Senators and even responsible persons within the Interior Department concede that what has been developed to date in terms of such a policy is piecemeal, expedient and wholly inadequate.

## WASHINGTON

**AEC has extended Dawn Mining Co.'s** uranium mill contract to Dec. 31, 1966.

The original contract, covering operation of the firm's processing mill at Ford, Wash., was signed Aug. 9, 1956, and would have expired March 31, 1962.

Newmont Mining Corp., New York, has a majority interest in Dawn, and Midnite Mines, Inc., Spokane, has a minority interest in the firm. Dawn operates a 400-tpd uranium mill at Ford and the Midnite uranium mine on the Spokane Indian reservation.

**Washington Gov. Albert D. Rosellini predicted a "prospectors' rush" may develop in north central Washington State** as a result of a state-sponsored survey of iron ore deposits.

The governor, speaking at the annual Prospectors' Day celebration at Republic, said the full report on the state aerial survey will be published in June. He said preliminary examination of the survey data indicates several areas of interest that will stimulate additional exploration work by prospectors and mining companies to develop new deposits of iron ore, uranium and possibly other metals.

The aerial survey covered a 935-square-mile area of northwestern Ferry

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*The Colorado Fuel and Iron Corporation*

## Washington *(Continued)*

County and northeastern Okanogan County. Purpose of the survey was to discover magnetic hot spots which could be further explored by diamond drilling.

**Sunny Peak Mining Co., Spokane, announced plans to develop a vein of copper-silver ore** at the Mohawk property near Conconully. The vein was uncovered by bulldozing last year.

The vein was found under 20 ft of overburden at a location downhill from the No. 2 Mohawk tunnel, according to C. J. Weller, Coulee City, manager of the operation.

The company has retained C. E. Tedrow, Spokane, as consulting engineer. The firm also reported it has taken a new option on the adjoining Mineral Hill property.

**Grandview Mines, Spokane, reported a net loss of $35,570 for 1959** after depletion and depreciation deductions of $23,766.

The firm said total income was $44,363. This included $35,935 from oil sales and $10,872 in royalties from American Zinc, Lead and Smelting Co., which runs the Grandview lead-zinc mine near Metaline Falls.

President Karl W. Jasper predicted that oil production would increase substantially in 1960 and he said royalties from the Grandview mine would be up to three times the 1959 figure.

**Daybreak Uranium, Inc., Spokane, reported work will be started on the opening of a new uranium orebody** at its property in the Mount Spokane mining district.

The firm, with Herb Sams, Elk contractor, has drilled 20 new exploratory holes in an area near the firm's former open pit mining operation and ore was found in half the holes at depths of up to 36 ft.

**Pend Oreille Mines and Metals Co., Spokane, reported first quarter 1960 profits of $105,053** compared with a net loss of $12,008 for all of 1959. President Jens Jensen told stockholders at the firm's annual meeting that enough ore is available at the company's Metaline Falls property to provide a 10,000 tpd operation.

He said the company is faced with a continuing heavy cost in fighting applications for dam permits on the Pend Oreille river which he contended could flood the company's mining properties in the Metaline district. The company previously had attributed its losses last year to the expense of presenting testimony at a series of Federal Power commission hearings.

**The Spokane office of the Bureau of Mines plans to begin exploration work for beryllium and cesium** in Montana, Idaho and Washington. Bureau engineers will do sampling work with a new mobile spectroscopic laboratory.

The exploration work was to be started in May in Idaho. The Federal agency will be working in cooperation with the Idaho Bureau of Mines and Geology at Moscow, Idaho. Under the agreement with the state agency, one of the first agreements of its kind, the Spokane staff will perform studies on engineering and sampling work and the Idaho agency will handle advance reconnaissance and the geological studies.

## WYOMING

**Tidewater Oil Co. and Kerr McGee Oil Industries, Inc. are negotiating with the AEC** on establishment of a concentrator in Wyoming's Shirley Basin.

Allan Jones, general manager of the AEC's Grand Junction Operations Office, confirmed that the two operators—pioneers in the district—had opened the formal talks with the Commission.

However, he said that it was always possible that these talks might be resolved by having their ore shipped to existing mills.

Mr. Jones said that Tidewater and Kerr McGee had blocked out "substantial" reserves of ore in the Basin prior to Nov. 24, 1958.

The AEC does not buy concentrates in the 1962-1966 purchase period from ores discovered after that 1958 date.

**Another major expansion in soda ash production at its Green River plant has**


Photo - Courtesy, United States Steel Corporation.

Tough cars for a big job . . .

In 65 years or so the first dipper hole at Mesabi has grown to the tremendous open pit pictured here in part. Differential Air Dump Cars first put in appearance at Mesabi in 1925. Veterans of many years and thousands of tons, these cars have carried their loads uncomplainingly. Steady reorders have a pleasant way of nodding approval. We would be glad to tell you more about Differentials — how they're made and why you'll like them.

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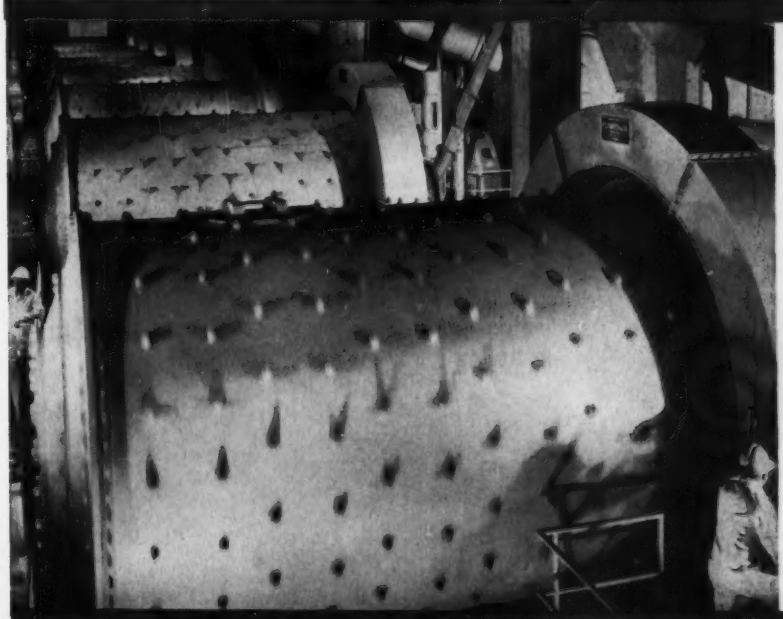

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## Wyoming *(Continued)*

**been announced** by the Chlor-Alkali division of Food Machinery and Chemical Corp.

The firm will expand its capacity from 520,000 tons a year to 720,000 tons a year by 1962.

First phase of the expansion will be completed by early 1961 and the second 100,000 ton increase is planned for early in 1962.

**Globe Mining Co., subsidiary of Union Carbide Nuclear Co., has been presented a National Safety Council citation for 63,951 man-hours of accident free uranium operations** at its east Gas Hills uranium operation in Natrona County. The award was for 1959 operations.

Globe Mining, operators of the fifth uranium mill in Wyoming, started production in January, 1960 at its 492-tpd mill.

**Powder River Mining Co., Buffalo, has leased 18 claims in the Big Horn mountains** 48 miles southwest of Buffalo to a Montana group which plans a strip gold mine.

Stockpiling of gold ore started in mid-May and a mill will be put into operation about July 1.

Max Wilk of Billings, Mont., was named manager of the mining operation. Tom Kyama, Hardin, Mont., and Harold Blair, Billings, head the group which obtained the leases.

Powder River maintained a 12½% royalty on the mine's production.

The mine was discovered near the head of Bader's Gulch near the headwaters of the Powder River in 1933. John White discovered the ore deposits which were operated for several years in the 1930s. The mine has been idle for several years.

# IN LATIN AMERICA

## CHILE

**Workers at the new El Salvador copper mine and mill,** as well as those at the smelter at Potrerillos, voted in favor of a strike after their union failed to come to an agreement with management on the question of an increase in wages and fringe benefits. The strike was to begin on May 1, but at the last moment both parties consented to nominate a mediator from the Ministry of Labor. Señor Víctor García, technical adviser to the Ministry was designated mediator.

**Workers at the large coal mine of Lota and Schwager,** which together produce about 90% of all the coal mined in Chile, have been on strike for 45 days. Since all efforts on the part of the Administration to end the strike had failed, the suggestion to nominate an arbiter was accepted. From the three persons suggested, the miner's union chose Señor

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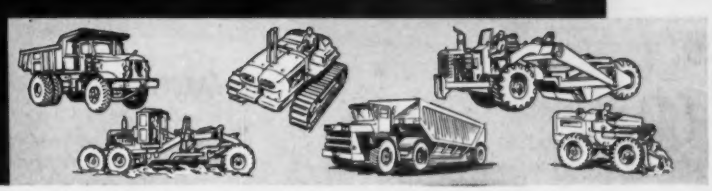

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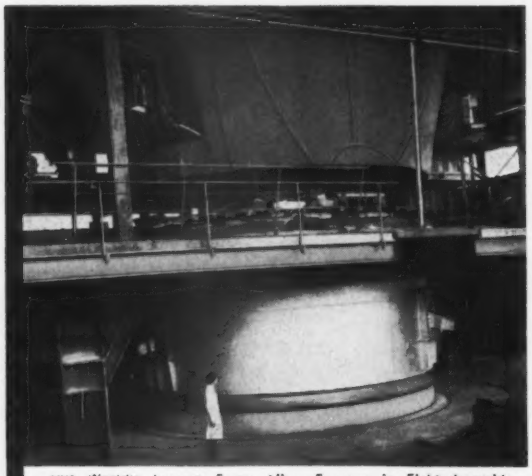

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## Chile *(Continued)*

Mariano Puga who was Chile's Ambassador to Washington three years ago. Besides the miners from these two large coal mines, workers from several coal mines such as Pilpilco and Colico Sur are also on strike. Under the circumstances the government has been compelled to import coal from the United States since most of Chile's railroads run on coal.

**Acting in accordance with special powers** given by Congress to the present Administration to legislate for one year on economic and administrative matters by Decree-Law, the Administration has drafted D-L #256 which either eliminates altogether or reduces import duties on many supplies used by the mining industry such as Diesel oil which will reduce mining costs.

**The United Nations, in a special agreement with the Chilean government,** has nominated Mr. Dahlstrom to work with the Chilean Institute of Geology on the geological map of the Atacama desert. Besides the geological work, which will be conducted by various geological teams or commissions, a certain amount of prospecting work will also be done.

**The Administration has prohibited the exportation of scrap iron** which was beginning to become scarce in the country. Scrap iron is used exclusively as a precipitant on the copper solutions in a number of small leaching plants in the provinces of Antofagasta, Atacama and Coquimbo, where oxide copper ores are abundant.

**A higher price for copper** which rose from 20.0 to 29.6¢ in Europe, where most of Chile's copper is sold, as well as an increase in production from 420,000 metric tons in 1958 to 496,745 metric tons in 1959, resulted both in greater profit for the mining companies and larger taxes for the State. Thus taxes paid in 1959 were U.S. $32,335,000 greater than in 1958; dollars spent in the country to pay for wages, salaries, supplies, etc., increased from 60 million in 1958 to 80.6 millions in 1959 and new investments rose 5.5 millions in the same period. All told, the dollar value spent in Chile by the large copper mining companies increased from 131.6 to 190 million dollars.

**Compañía Minera Santa Fe,** which owns several medium and small high grade iron ore deposits in this country as well as the large Laco mine near the Argentine border in Antofagasta Province, will soon start exploiting the El Carmen iron mine near the town of Pueblo Hundido. The ore from this mine will be transported by a long belt conveyor to the railroad and loaded at the port of Chañaral.

## MEXICO

**The Mexican government has changed its laws governing minerals exports,** leaving the door open for mining com-

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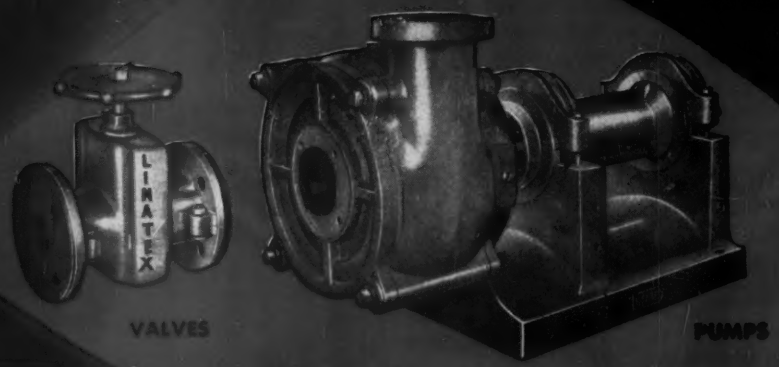


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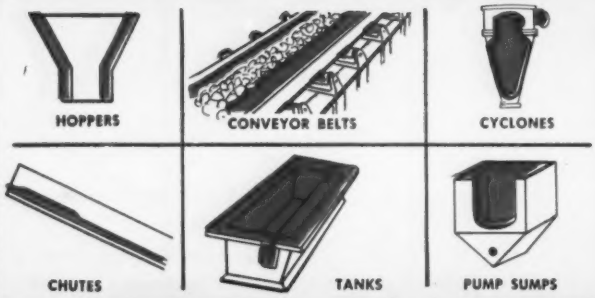


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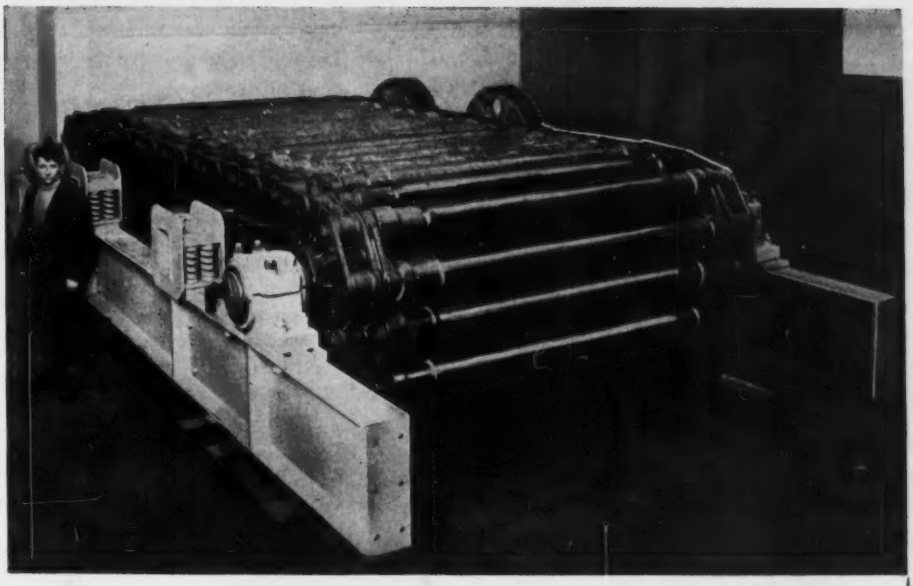

Photograph shows a No. 10 Ross Patent Drop-Bar Feeder assembled before despatch to Llanddulas Quarries for feeding a 60" x 42" Jaw Crusher. The photograph illustrates the very heavy construction of the apron, in this case 7" dia. steel bars at 10" centres and the heavy shock-absorbing coil springs which support the apron.

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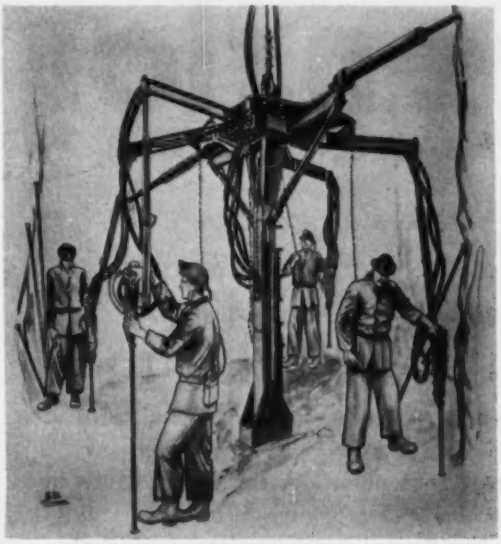

**Shaft Jumbo Drill**

This simple rugged Shaft Jumbo using retractable air leg drills can be collapsed and lowered through a 48" sq. shaft area. The Jumbo can also be used with hydraulic jibs equipped to power feed drifters.

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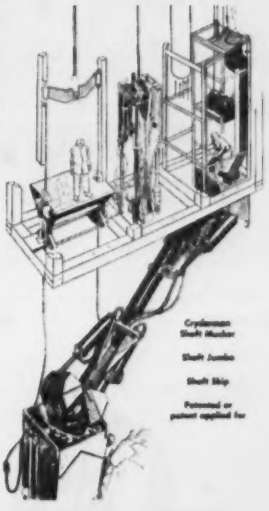
The Cryderman is a high speed maneuverable shaft machine for mucking vertical shafts, inclines or slopes. This rugged equipment is custom designed to fit your specific problem.



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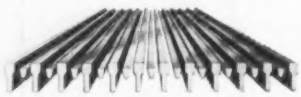
### T-WEDGE KLEENSLOT



A new concept in guard bar design. T-shaped wire replaces typical "bar" to increase screening surface while keeping large unscreenable lumps of material above the tolerance governing lower screening surface.

### F217 and F250 KLEENSLOT

Manufactured with large size wedge shaped wires to maintain maximum efficiency over an extended period in abrasive applications.

Although large in wire size, this screen will easily maintain openings as close as 1 m.m.

### G187 and GB187 MIGH-TEE KLEENSLOT

Special profile increases wearing surface. This is a heavy duty precision type screen that will easily maintain openings smaller than ⅛ m.m. and openings larger than ordinarily considered economical.

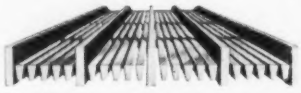
### "S" KLEENSLOT

Engineered for applications where screening out of flats or slivers is of prime consideration. Can be also furnished in a "C" bend. Recommended for applications requiring openings larger than 1 m.m. For smaller openings, see Marcel screen.

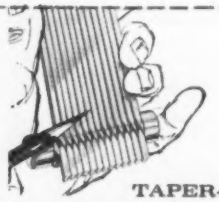
### MARCEL

This screen, while screening out "slivers," presents a flat surface for materials to wipe the opening clean. Available with openings up to 1 m.m.—for larger openings see "S" screens.

### SCREEN GUARD

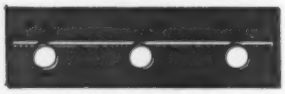


Vertical guard bars keep larger unscreenable materials above the actual screening surface. This increases screen life and promotes much greater efficiency in dewatering.



### TAPER-SLOT

From loop to loop, the screen opening gradually increases. This design is to eliminate blinding when screening large amounts of near-opening size materials.



For example: .016 opening tapered to .024—the combination of opening sizes would be the same between each loop throughout the entire screen.

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## Mexico *(Continued)*

panies to get up to 100% relief on export taxes. Mining companies in Mexico have long complained that they are being unduly punished by severe export taxes, thus making it hard for them to compete in the world market.

Last week, word from Mexico's Treasury Dept. had it that the government was now ready to put out the rules and regulations of just how mining companies could get this relief. According to officials of the Mexican Mining Assn., the taxes on exports must be changed or "Mexican mining will continue on the road to disaster."

Enrique Casas Alatriste, head of the Federation of Mining Associations in Mexico, stated there are three other points under study. 1. Total exemption of taxes for five years may be extended to new mining ventures. 2. The government may supply up to 50% of new investment costs. 3. The government may help small mines with credit for new exploration or expansion of production.

Casas Alatriste pointed out the fact that in the last decade, Mexican mining production has dropped in value some $80-million.

**Salvador Peña, Sub-Secretary of the National Patrimony in charge of Mining, has outlined a plan for the "Mexicanization"** of mining (about 86% of Mexico's mining industry is in foreign hands).

Recently, the Texas Gulf Sulphur Co. suspended operations on Mexico's Isthmus. This was for "economical" reasons, Peña said, explaining that there were leaks in the sulphur dome, making the production of steam overly expensive. The government, he said, was considering taking over this sulphur operation to save the jobs and the production of the mine, even though it was not economical for a private company.

He said that the government took over mining operations only when the production and the jobs were needed for the area—such was the case of the Real del Monte Mine in Pachuca he said (5,000 jobs depended on the mines operation).

On the other hand, Peña pointed to an example where private Mexican capital was taking over functions in mining started by the government—and in conjunction with foreign capital. The Hooker Co. has recently embarked on a deal with private Mexican groups to get phosphates from low grade phosphoric rock. Hooker will, as a minority partner, also go into the mining of the phosphoric rock for production.

In another "Mexicanization" deal, Peña said that the Peñoles Mining Co., a subsidiary of American Metal Climax, was working on a deal to sell part or all of its Mexican holdings to a private Mexican group. He added that the American Smelting & Refining Co. was ready to take on Mexican interests in its 100% owned Mexican holdings. Cananea Mining Co., is also interested in taking on Mexican capital, he said.

In answer to the question of whether the government was interested in taking over the sulphur mining operations on the Isthmus, Peña said "no." He explained that the government would like to see these companies take on Mexican private capital if Mexican private capital was available.

# IN ASIA

**India's Commerce & Industry Ministry has approved a scheme** to put up a 20,000-ton aluminum plant in the Ratnagiri district of the new state of Maharashtra, close to the site of the upcoming Koyna dam and power stations where bauxite deposits have been found to be adequate.

The scheme put forward by Tendulkar Industries of Bombay is in collaboration with the Aluminum Company of America. Mr. Tendulkar currently is in the United States.

The project's total capital outlay is estimated to be around $30-million. However, the exact size of the plant and the total investment involved are yet to be worked out, although a tentative capacity of 20,000 tons is proposed.

It will be the second of its kind to be built in India with US help; the first, by Kaiser in collaboration with the Indian Birla Bros., is now going up in the North Indian state of Uttar Pradesh.


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## DAILY "TOOTH REPAIR" ELIMINATED BY SWITCHING TO AMSCO 2-PART TEETH

Mount Vernon Contracting Corp. is a large general contractor doing work throughout the middle Atlantic states. Its present contract is for road construction on the Cross Westchester Expressway, linking the New York State and New England Thruways.

The firm's four power shovels and two backhoes on this job are equipped with Amsco dippers or dipper parts and Amsco Simplex* 2-Part Teeth. Reason: competitive teeth previously used required daily welding build-up to maintain their points. Now, since switching to the Amsco Simplex, teeth are changed only about once a week. And change-over is *only a 5-minute job!*

With shovels operating 8 hours a day, 5 days a week, this is a mighty important advantage for Mt. Vernon. No wonder they say—"These Simplex teeth really stand up in service, especially in rock, and save us a lot of downtime."

*Patent No. 2,904,908

AT HIGHWAY MACHINERY COMPANY

## AMSCO CRUSHER ROLLS HANDLE 50,000 YDS. BETWEEN BUILD-UPS

Carroll Hicken (left) owner of Highway Machinery Company, Waukesha, Wisconsin, is a long-time user of Amsco equipment. His firm designs and manufactures self-propelled machines for crushing road material, both gravel and stone. All of their machines are rented out or sold to contractors, with maintenance and service handled by Highway Machinery.

For years, the company has used Amsco Manganese Steel Crusher Rolls exclusively. Amsco Manganese welding rods and bars are also used for build-up. On a typical rental machine, pictured at right, the Amsco rolls had *crushed over 50,000 yds. since their last build-up* six months before.

Mr. Hicken says that with Amsco Manganese rods he can multiply the life of a roll by 5 to 10 times. He adds—"They have proven very fine, and we're getting more yardage than with any rods we formerly used."

# AMSCO

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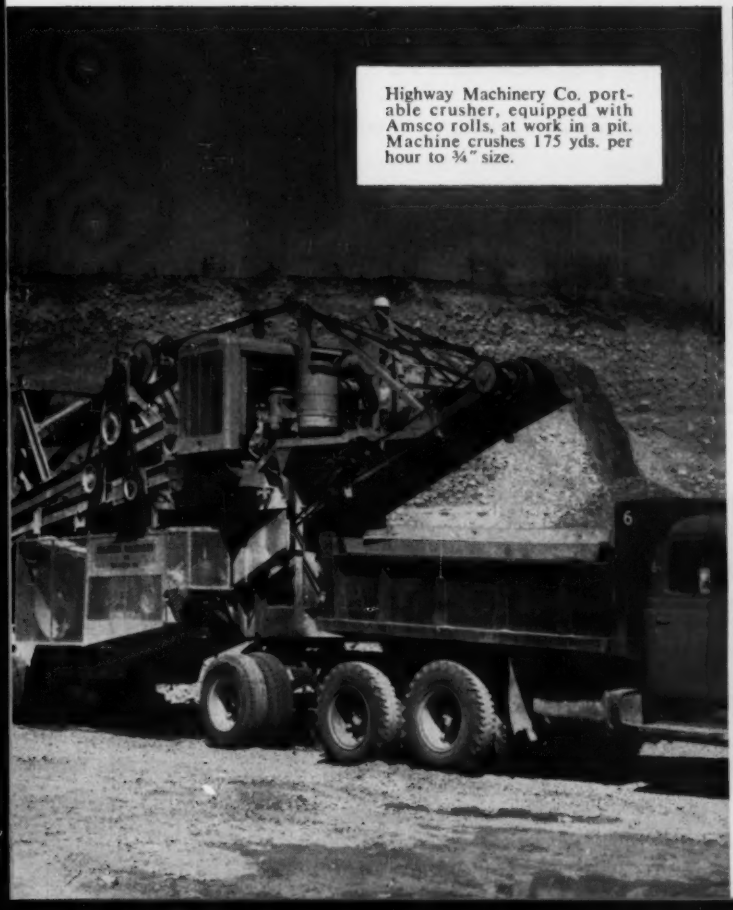
AMERICAN Brake Shoe COMPANY

◀ Northwest shovel, equipped with Amsco Dipper and Simplex 2-Part Teeth, at work on Cross Westchester Expressway project.

Shovel operator, Walter Reich, inspecting Amsco Simplex 2-Part Teeth used on Mt. Vernon Contracting Corp. shovel. ▶

Highway Machinery Co. portable crusher, equipped with Amsco rolls, at work in a pit. Machine crushes 175 yds. per hour to ¾" size.



Amsco 25 x 24 manganese steel crusher rolls, of type used in portable crusher at left.

Welder demonstrating how Amsco Manganese rods are used for build-up on rolls.

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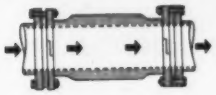
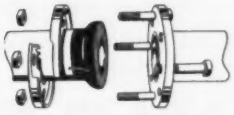
- Temperatures to 200° F.
- Patented "hinged" sleeve. Recesses serve as "hinges" during compression; reduce strain and permit tight closing.

- Cannot leak or stick.
- No working parts in contact with pulp or liquid; no packing glands.



- Unobstructed flow eliminates high friction loss.
- Remote control available.
- Can be equipped for automatic regulation.



- Split flanges and patented Flex Seal ends assure perfect seal.
- Closing mechanisms... manual handwheel; handwheel with chain and sprocket reduction unit; electric worm gear motor reducer; chain operated torque arm reducer; hydraulic; air-hydraulic.

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## Asia (Continued)

**Vietnam will get a three-year mineral** survey from the UN's Special Fund for study of four known ore deposits with a view to investments and production.

The survey, to cost $245,000, will study in detail deposits of magnetite at Phong-Diem, copper at Duc-Bo, molybdenum and Wolframite at Kron Pha, all in Central Vietnam's Annam mountains.

**Thailand has obtained the services of a French government geologist** to help determine the scope of copper deposits in the northern area of the country.

The government is trying to attract foreign firms for the mining and processing of copper, gold, iron and manganese ores in the country.

Special inventives would be granted to processing of local iron ores from smelting up to the stage of steel production, and to processing of manganese alloy up to international standard of purity.

# IN EUROPE

**Austria's biggest lead-zinc mining and processing enterprise, the "Bleiberger Bergwerks Union—BBU" of Klagenfurt,** Carinthia province, is so deeply in the red that state funds must be pumped into the firm to keep it afloat long enough that investments accomplished may turn the fate of the company. The annual balance for 1958 shows that 14.4-million AS ($554,913) were added as 1958 business loss to the 1957 loss, bring up two-year losses to 25.1 million AS ($967,245) or roughly 35% of the stock capital.

Managed by one (politically-appointed) "Public Administrator," the BBU made large investments during the past five years, at a time when lead and zinc were scarce commodities internationally. The Gailiz zinc processing center was dimensioned from the start to far exceed domestic ore supplies, counting on Italian zinc ore for refining on Italian orders.

**Sicily's first modern, fully automated kyanite mine and processing plant have started simultaneous operation,** after a record-breaking eight-month construction effort built the sprawling facilities necessary to extract potassium salts from kyanite. The enterprise was built by Montecatini.

From Campofranco the potassium salts are transported by rail to Porto Empedocle, port city of Agrigento, where the material is transformed into potash and compound fertilizers. From Porto Empedocle, the fertilizers are shipped by sea to Italian domestic and foreign markets.

**Rio Tinto Company Ltd. of London, England has joined forces with Deutsche Gold- und Silber-Scheideanstalt (Degussa)** to form Nuklear-Chemie und Metallurgie Gesellschaft m.b.H. (Nukem).

Degussa is the only private manufacturer of nuclear fuel elements in Germany, and has had considerable experience in the processing of rare metals and compounds.

Mallinckrodt Chemical Works, through its subsidiary, Mallinckrodt Nuclear Corp., a U.S. producer of enriched nuclear fuels, is also a shareholder and has concluded a technical collaboration agreement with Nukem providing for exchange of information on the processing of nuclear fuel materials.

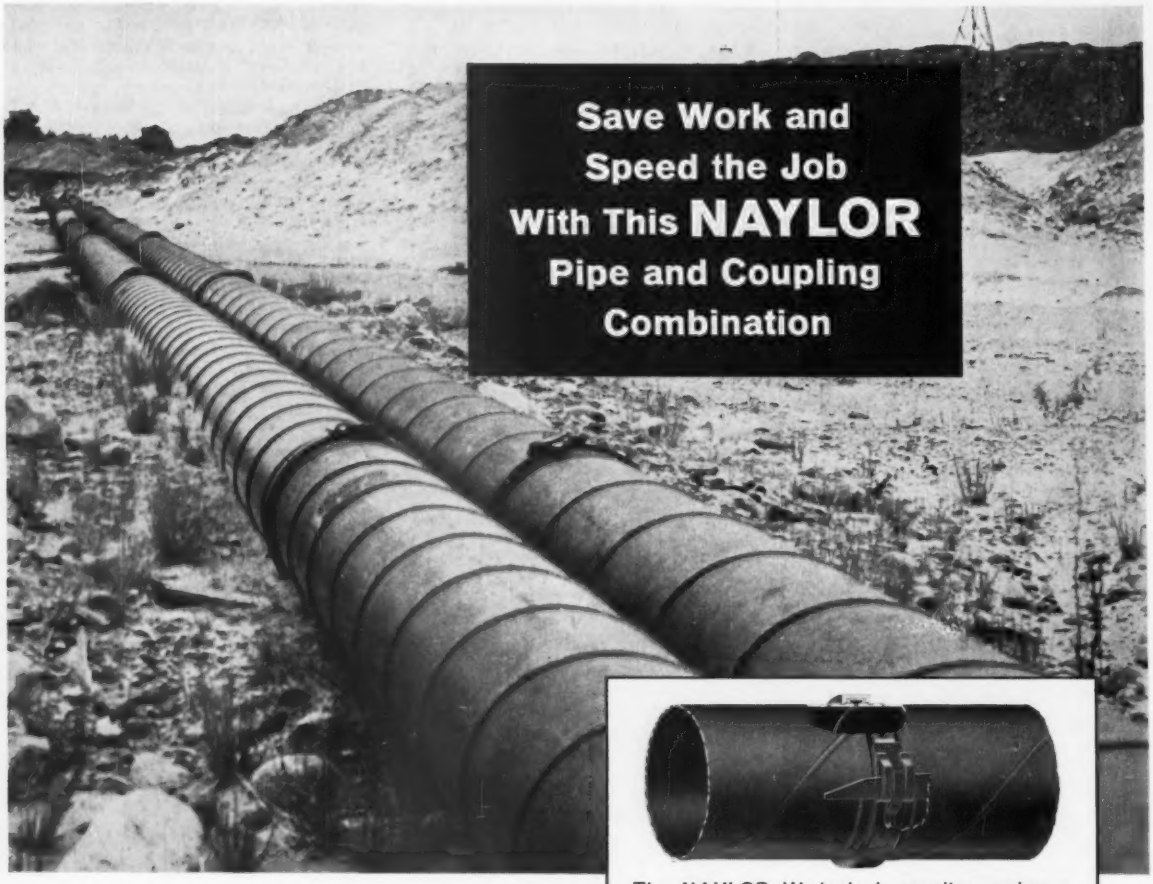
**Some 400,000 tons of ore were loosened by a big explosion at one of the biggest mines in the Urals,** near Sverdlovsk, U.S.S.R. Some 2,000 blasting holes, with a total length of more than 17 km, were drilled before the explosion. Sixty tons of ammonite were placed in them to set off one of the largest explosions ever detonated in a copper-pyrite deposit in the Soviet Union.

It was very effective according to the Soviets. The cost of the extracted ore decreased 25 rubles per cubic meter compared with the small explosion method usually employed, and the method has saved 10,000 cubic meters of timber.

**Concentrated geological efforts conducted in the USSR led to the discovery of new deposits of minerals usable for large-scale fertilizer production,** Pjotr Antorpov, USSR Minister for Geology

LESCHEN WIRE PORTER ROPE DIVISION
H. K. PORTER COMPANY, INC.

# PARTNERS IN PERFORMANCE






The NAYLOR Wedgelock coupling makes a positive connection, securely anchored in standard weight grooved ends. A hammer is the only tool needed to connect or disconnect it.

You can always count on NAYLOR Spiralweld pipe and NAYLOR Wedgelock couplings to work together for savings in time and labor on lines in mining service.

Since NAYLOR pipe is light in weight, it's easy to handle and install. But don't let this light weight fool you because the NAYLOR lockseamed-spiralwelded structure makes the pipe extra strong and safe for the tough service you give it.

You save time, too, through use of the Wedgelock couplings which are designed for faster, easier, more economical installation.

**It will pay you to look into this NAYLOR combination for air, water or tailings service. Just ask for Bulletin No. 59.**

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## Europe *(Continued)*

and the Conservation of Natural Deposits, told TASS.

The USSR possesses, it says, 1,607,000,000 metric tons of apatites, 2,015,000,000 metric tons of phosphorites, and 6,511,000,000 metric tons of kalium (potassium) salts.

# IN THE MIDDLE EAST

## U.A.R.

**A contract has been signed between Yugoslavia and the government owned El-Nasr Phosphate Co.** in the Egyptian region of the United Arab Republic for the purchase of 140,000 tons of phosphate rock during the year ending June 30, 1961.

El-Nasr Phosphate Co. is exploiting newly developed phosphate mines in the Nile Valley, around Esna, under the first Five Year Industry Plan.

The Yugoslav contract is part of a long-term agreement with Egypt calling for increased imports of Egyptian raw materials. Yugoslavia was the eighth importer of Egyptian phosphates in 1958 with 11,562 tons from companies exploiting mines in the Eastern Desert, near the Red Sea Coast.

## IRAQ

**The Iraqi Economic Planning Board has authorized the Ministry of Industry to sign a contract** with the Soviet Technoexport organization to carry out mineral prospecting and geological surveys over eight prospective mining zones covering 15,000 square kilometers in northern and northeastern Iraq, close to the Turkish and Iranian borders.

According to a draft contract drawn up by the two sides, Soviets will also carry out magnetic surveys over 500 square km near the town of Sulaimania, in northeastern Iraq.

# IN CANADA

## NEWFOUNDLAND

**Production from the base metals producer at Buchans** owned by Terra Nova, wholly-owned subsidiary of Anglo-Newfoundland Development Co., and operated by American Smelting and Refining Co. on a 50-50 profit-sharing basis, is expected to approximate 380,000 tons this year, up from 359,000 tons in 1959. Ore reserves at the end of 1959 were estimated at 5,360,000 tons, assured and probable.

**Advocate Mines expects that sufficient data will be available** by the end of June to permit the financing group of Canadian Johns-Manville, Patino of Canada, Amet Corp. and Financiere Belge de l'Asbeste-Ciment, to make a decision on production for the asbestos property at Baie Verte. Mill and product testing has been in progress throughout the spring.

## LABRADOR

**The pilot plant of Wabush Iron Co. Ltd. which has been built on the south shore of Little Wabush Lake** began operating in February. It has a capacity of 30 tons per hour and will have processed about 50,000 tons of crude ore by the end of 1960. The plant was built by the Henry J. Kaiser Co. of Canada and has facilities for screening, crushing and concentrating the crude material. The crude runs between 30% and 40% in iron and is concentrated to a 64% dry iron.

Jack Nutting, project engineer for pilot plant and railroad construction, with headquarters in Montreal, is in charge of the operation; R. J. Hawkanson is chief mining engineer; Allen Raby is


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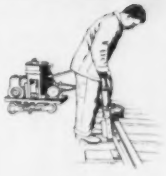

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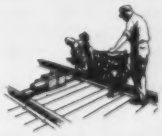
**TRACK SHIFTER**
To shift track laterally or to raise track vertically, thus considerably reducing the manual effort formerly required for this work.

**RAIL DRILL**
Lightweight, compact unit, easily set up and adjusted for fast, accurate work. Simple, self-tightening chuck.

**POWER WRENCH**
Removes or replaces the nuts of track bolts, fast, and with controlled torque in tightening bolts uniformly.



**POWER JACK**
This hydraulic machine eliminates another tough manual operation in ballasting and surfacing jobs. Reduces track raising cost and improves final results.

● *Write for further information on any or all of this modern money-saving Nordberg railway track maintenance equipment. Indicate any special problems you may have.*

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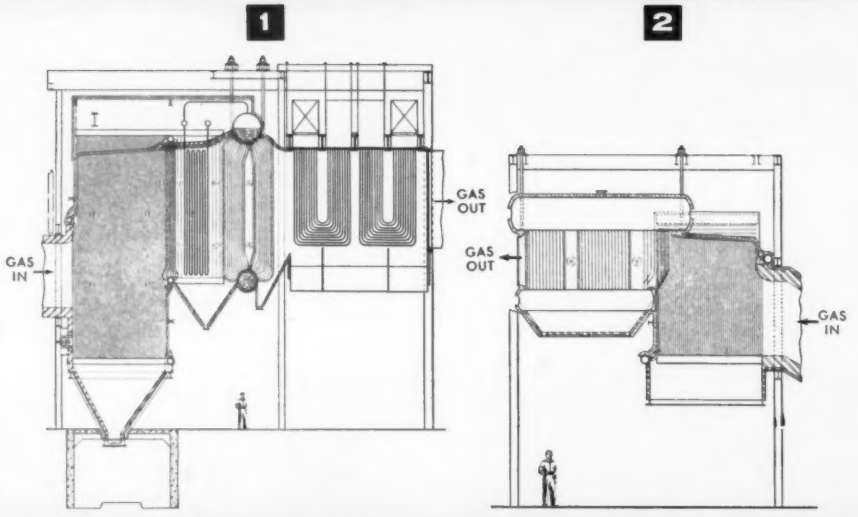
# Effective Utilization of Waste Heat in Metallurgical Processing

**CUSTOM-ENGINEERED B&W UNITS**

Illustrated are 5 B&W Heat-Recovery Units, typical of many currently serving the metallurgical process industries. Complete data on application and modification of these and other units will be found in B&W Bulletin G-88, previously mentioned. Please write for your copy today. Address: The Babcock & Wilcox Company, Boiler Division, Barberton, Ohio.

**B&W WASTE HEAT RECOVERY UNITS FOR**

1. Copper Reverberatory Furnaces
2. Refining Furnaces for Copper and other metals
3. Ore Roaster, Acid Plant or Kiln
4. Zinc Fuming Furnaces
5. Heat Recovery with high temperature air heating and corrosion section




## CONSIDERATIONS

The economic success of many metallurgical processes requires recovery of valuable heat and entrained product particles in waste gases.

In selecting or designing the best boiler for this important task, the following factors must be considered:

- **Quantity of waste gas**
- **Gas temperature**
- **Gas pressure**
- **Chemical constituents of waste gas**
- **Concentration of metallics and ash in waste gas**
- **Size and abrasive characteristics of entrained material**
- **Fusion temperature of material carried in waste gas**

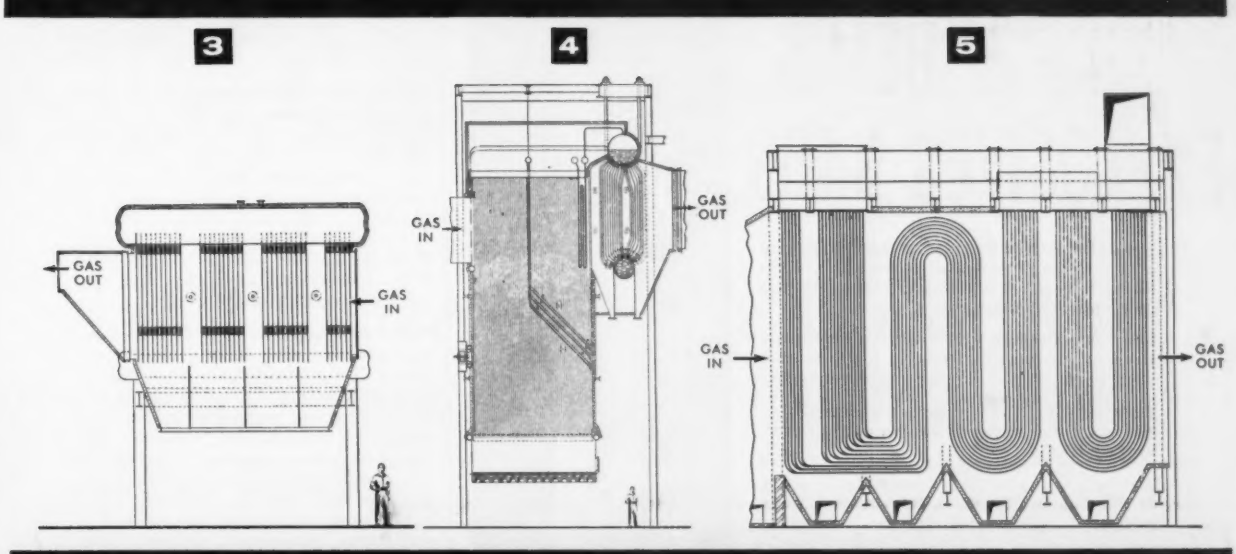
Specific operating requirements further complicate the problem of heat and product-particle recovery. For a complete discussion of Waste-Heat Boilers and their application, write for B&W Bulletin G-88.

# B&W DESIGN FEATURES

B&W heat-recovery and boiler-design specialists have years of practical experience in designing units for a wide variety of applications. Custom-engineered to meet specific process requirements, B&W Waste-Heat Boilers incorporate the following outstanding design features:

- Slagging problems are eliminated by cooling waste gases below the ash fusion temperature in water-cooled furnaces.
- Waste gas leakage and acid corrosion are eliminated by providing pressure casing. The casing temperature is maintained above the dew point of corrosive constituents in the gases. This inner casing permits operating up to seven inches w.g. gas pressure.
- Tube erosion by gas-borne material is eliminated and low-draft losses are obtained by designing for low-gas velocities, with no gas baffles in the tube bank.
- In-line tube arrangements used throughout permit efficient tube bank cleaning by soot blowers, or hand lancing when appropriate.
- High-efficiency B&W Cyclone Steam Separators prevent solids carry-over in the steam, thus protect against superheater and turbine fouling difficulties.
- Complete visual observation of all heating surfaces is provided with ample, properly located doors and lance ports.
- Hoppers wth steep sloping sides and large outlet connections prevent material "hang-up."

These built-in features assure continuous, trouble-free operation with low maintenance and high efficiency from every B&W Waste-Heat Boiler.




B&W Bulletin G-88
— "Effective Utilization of Waste Heat"
— on request.

ME-101

B&W

THE BABCOCK & WILCOX COMPANY

BOILER DIVISION

## Labrador *(Continued)*

project accountant and James Robb is mine superintendent. Harry Gerber, former superintendent of the Hilton Mines in Quebec, has been assigned to special duties in connection with the development of the Wabush mine and permanent plant.

## ONTARIO

**Caland Ore Co., subsidiary of Inland Steel Co. of Chicago,** has started production from its iron property in the Steep Rock Lake area. Ore is being drawn from two open pits on the floor of the former lake. It is expected that 750,000 tons will be shipped this year with gradual increase to 3-million tons per year by 1965. (See p. 114.)

**Aunor Gold Mines, gold producer in the Porcupine area,** has contracted with the neighboring Delnite Mines for the driving of a new heading on the 3,250-ft level. The drive will test vertical continuity of ore opened last year from a similar drive at the 3,500-ft horizon. Present ore reserves to the 2,900-ft level are sufficient for four years operation at present treatment rate.

**Rio Algom Mines is to embark on a major shaft sinking program** later this year at its Algom Quirke uranium property in the Elliot Lake area. The shaft, to be put down about 6,000 ft southeast of the present production shaft, is designed to tap the plunge of the Quirke orebody. The new opening will be to depth of 1,700 ft to open six levels to the 1,500-ft horizon and will be connected with the Quirke shaft on the 900-ft level.

**Denison Mines, the company formed by amalgamation of Consolidated Denison Mines and Can-Met Explorations,** upped production at its Elliot Lake uranium mine in the first quarter of the current year to $12,750,000 from $11,497,000 in the corresponding period of 1959. The amalgamation has assured Denison of large scale production for several years in permitting the company to take advantage of the stretch out of uranium shipments to Eldorado.

**Recovery grade at Renabie Mines has shown a substantial increase** in the first quarter of this year. Grade jumped to $8.50 per ton from an average of $6.27 per ton for the full year 1959. Average for the corresponding period of 1959 was $6.19 per ton. Extensive surface and underground exploration are planned this year for the Missinaibi area gold producer.

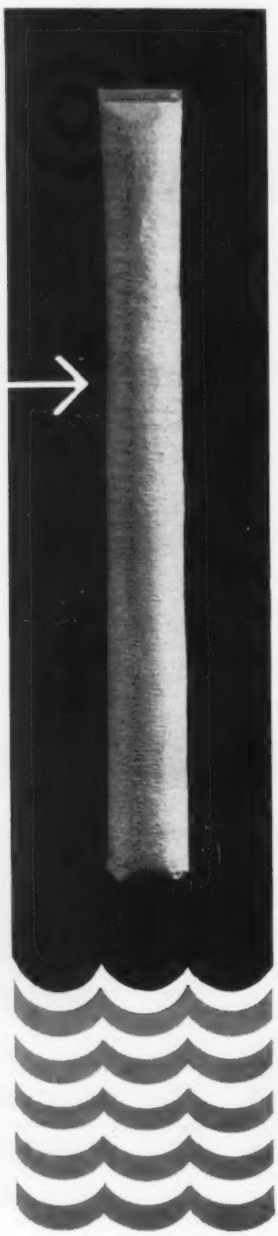
**Leitch Gold Mines is continuing to open up rich high grade gold ore** on the bottom level at its producing gold mine in the Beardmore area. At last report the No. 2 vein on the 28th level has been opened for a length of 420 ft—averaging 3.5 oz gold, cut grade, across 21 in. This is almost double the length of the same high grade shoot opened on the 26th level. Crosscutting to the ore has now been started on the 30th level.

**Initial development on the deep levels** at the gold producing Kerr-Addison Gold Mines in the Larder Lake area, has indicated decreasing volume of ore, it was disclosed at the company's recent annual meeting. It was officially announced that, unless there is a substantial expansion in ore, present mill rate will eventually have to be reduced. However, this latter move is not imminent. Proved ore reserves, it was stated, are sufficient to yield about 65% of the total gold produced since the mill started 22 years ago.

**Depth development at the Geco Mines' copper-zinc-silver mine** in the Manitouwadge area, has disclosed ore comparable to that already developed on the upper levels. The 'C' zone has been intersected in diamond drilling from the 2,050-ft level, the deepest point at which the zone has yet been tested. Since the first of this year the company has reduced its loan by over $3-million leaving a balance of under $1-million to be paid off.

**Falconbridge Nickel Mines has started sinking of the first development shaft** at its Strathcona nickel property in the Sudbury area. It is anticipated that Strathcona might prove to be the largest mine the company has at present. It will take some five to six years to bring the property into production and, while detailed plans have not been formulated, the


*Tailor-made to give you more efficient blasting!* **BEMIS EXPLOSIVES BAGS**



Bemis Explosives Bags for ammonium nitrate and nitro-carbo-nitrate explosives are tailor-made to your requirements — to give you more efficient blasting.

**More economical:** Use of Bemis Explosives Bags and ammonium nitrate mixtures can save up to 50 percent on explosives costs.

**Easy to fill:** Bemis provides technical assistance, manufactures equipment to speed up bag filling.

Wet hole or dry hole . . . here are just a few of the Bemis Explosives Bag constructions in use:

**Burlap bag with heavy-duty polyethylene liner.** The rugged burlap absorbs the punishment of handling or jagged holes. Poly liner provides waterproofness.

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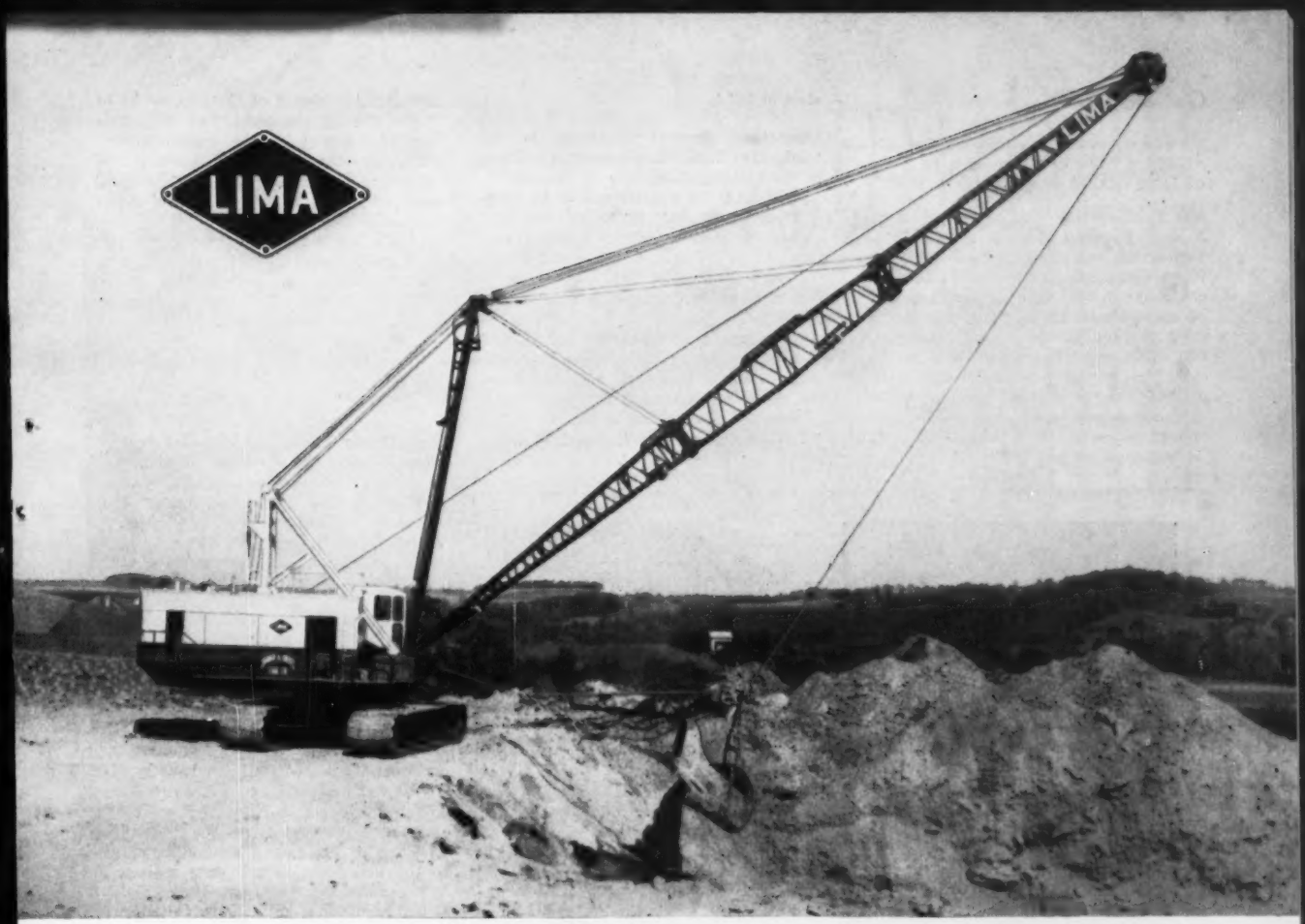


**Giant Lima 2400 dragline** equipped with 7-yd. bucket moves an estimated 3000 yd. in 9-hr. shift.

# 7-yd. LIMA dragline works 19 hours daily; maintenance less than $50 in 2 years!

"The Lima 2400 dragline is the best equipment buy we've ever made. It recovers about 500 tons of coal a day, working a 10- and a 9-hour shift. Yet maintenance costs in 2 years have amounted to less than $50."

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"I checked before I bought the Lima—for my money, Limas are bigger, heavier and better built than comparable rigs of other makes. From wide, heavy duty brake and clutch bands to shock-reducing torque converter, the 2400 is designed to outwear, outlast and outstrip other machines on the market.

"I was impressed by the field service that the factory engineers provided in adjusting the new machine for me. They also saw to it that my operators were thoroughly familiar with the 2400. Both parts and service from factory and distributor are excellent. We also have a Lima Type 34 Paymaster. Both Limas have proven to be high performance, low maintenance machines." *From a report by the Harold A. Siegel Coal Co., Clarion, Pa.*

**Make more money**

Chances are a Lima could help you make more money by stepping up production and reducing operating costs because of its low maintenance requirements. Get the facts about Limas before you buy your next machine. There's a type and size exactly right for your needs. Variable capacity draglines; shovels to 8 yd.; crawler cranes to 140 tons, 75 tons on rubber. For complete information, see your nearby distributor or write to Construction Equipment Division, Baldwin-Lima-Hamilton Corporation, Lima, Ohio.

***NEW 5-YD. LIMA LOADER*** **digs, scoops, swings and loads from stationary position; no waste motion. Fast, economical way to handle bulk materials.**

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6027

## Ontario *(Continued)*

company has been looking into the possibility of bringing the mine in at a rate of from 4,000-6,000 tpd.

**Rio Tinto Mining Co is carrying on extensive diamond drilling** at the large Temagami iron project optioned from North American Rare Metals. The present program will include the deepening of the shaft to 1,200 ft and for lateral work to provide ore for bulk sampling and metallurgical testing. The option agreement provides a plan whereby the property may be brought into production at a minimum rate of one million tons of iron pellets yearly with production to start in 1964.

**Canadians' greatest challenge is the earth,** says James E. Thomson, president of the Geological Society of Canada.

With half the country still to be mapped even in the sketchiest manner, "What a frontier exists beneath our feet," he said.

"We have a great and thrilling objective here on earth; let others reach for the moon."

Canadians must tackle the job of uncovering more of their mineral riches with the same thorough process—budgets, time-tables and defined objectives—used in the conquest of space.

Dr. Thomson, who is assistant chief provincial geologist of Ontario, spoke at 1,500 mining engineers and geologists met in Toronto for the annual conference of the Canadian Institute of Mining and Metallurgy, the Geological association and the Mineralogical Association of Canada.

While scientific manpower is successfully overcoming the challenge of space, "geo-scientists are experiencing many difficulties in attempting to conquer plant Earth," Dr. Thomson said.

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Triangle Brand Copper Sulfate
...is a flotation activator for lead, zinc and uranium ores that is 99% pure and available in several sizes from nearby stocks.
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## QUEBEC

**New Hosco Mines has obtained indications of new ore** at depth in diamond drilling at its copper property in the Mattagami area. The new intersections were cut well to the west of the main orebody and represent the deepest values yet encountered. The full significance of the new find has yet to be fully determined.

**Shaft sinking at the Consolidated Vauze Mines' base metals property** in the Noranda area is expected to be completed by August. At that time lateral work will be started to test the drill-indicated orebodies down to the 600-ft horizon.

**Bruneau Mines has contracted for a 10,000-ft diamond drill program** on its base metal prospect in Bruneau Twp, some 65 miles north of Senneterre. The drilling is designed to test strong anomalies, close to the Bell River, which were indicated by reconnaissance survey. Further detailed geophysical surveying is also proposed.

**Decision has been made to proceed with production plans** for the Chibougamau area copper property of Portage Island (Chibougamau) Mines. Underground diamond drilling has indicated an estimated 660,000 tons between the 250- and 700-ft levels with average grade 2.74% copper and 0.117 oz gold (cut grade) per ton. Drilling is continuing. Under agreement, the company's ore would be treated at the nearby Copper Rand mill at a rate of up to 800 tpd.

**Preliminary diamond drilling at the Normetal Mining Corp. base metal producing mine** has indicated extension of the mineralized zone 800 ft below the deepest developed level at 5,350-ft. Results from drilling on the 6,160-ft level have been below ore grade but it will take until the end of the current year to complete the drifting and drilling on this level.

**Lake Asbestos of Quebec has started the current year with a substantial increase in production,** sales and shipments of asbestos from its open pit operation at Black Lake. Shipments in the first quarter were up 11,662 tons over the same period of 1959 and March production reached a new high since the start of milling operations.

**Akasaba Mines is shipping ore from its Bourlamaque area gold mine** to the nearby Bevcon Mines' mill at a rate in excess

*(Continued on p 384)*

# These TYLER screens float– so you save structural costs

This battery of Tyler vibrating screens, in a plant of the latest design, is handling copper ore at a high production rate, and does its work without transmitting vibration to the base frame of the screen.

The vibrating screen body—as well as the drive shaft—floats on special rubber mounts. And moving parts are designed to be in dynamic balance at all times. With all the machine's energy being used to separate the materials, there's no need for secondary building structures and supports. Many Ty-Rock screens rest in operating position by their own weight without any bolted attachments.

Ask your Tyler representative to give you full information—and recommend equipment perfectly matched to your needs. That's Tyler Screening Service.

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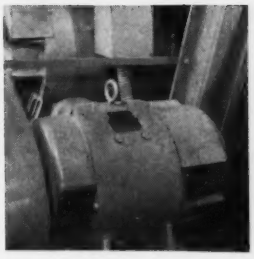
# THE MAN & THE MOTORS



## Mr. Westinghouse* and dependable d-c motors help Marriott-Reed move up to 18,000 cubic yards of overburden every 24 hours

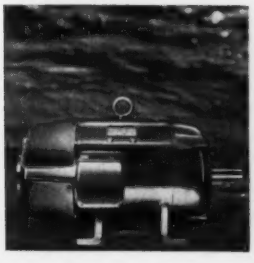
Westinghouse motors totaling 312 peak hp swing the big 360-ton, 12-cubic-yard drag line day after day with little maintenance or down time.

Superintendent J. E. Linn, Marriott-Reed Coal Company, Columbia, Missouri, says: "We have been using Westinghouse motors in our mining operation since I began working for A. E. Marriott back in 1926. There is no question but that they are rugged and dependable."

Mr. Westinghouse can help *you* solve any drive problem, too . . . with the correct motor for the job.

**Clyde Kennett, St. Louis, Missouri office*

# FROM WESTINGHOUSE



## Rugged d-c motors and Mr. Westinghouse† helped Omar Mining Company reduce costly down time

More than 100 motors, ranging from 5 hp to 150 hp, are used at Omar's No. 15 Mine to assure continuous output from three coal conveyors. Three 25-hp motors drive the vital Long-Airdox conveyors from one mining area to another. Costly down time is reduced because these Westinghouse motors are designed for maximum stamina in armature and commutator, local heating is prevented by controlled ventilation, and their factory packed bearings need no lubrication.

†*I. M. Rowe, Charleston, West Virginia office*

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## Quebec *(Continued)*

of 200 tpd. First shipments were made in March of this year and have been gradually increased with eventual objective of 250 tpd. Initially, grade was below mine average due to inclusion of ore from development and stope preparation.

**Campbell Chibougamau Mines is driving into the Henderson zone** on three levels at its Chibougamau copper property. The zone and its offset are estimated to contain 7.1-million tons averaging 2.62% copper and 0.072 oz gold per ton. Shaft sinking to an initial depth of 800 ft at the Henderson mine was completed recently and drives were then started on the 100, 275 and 525-ft levels. At the main mine, preparations are being made for the sinking of an internal shaft from the present bottom level at 1,900 ft to depth of 3,700 ft.

**Value of production at the big Chibougamau copper-gold producing property** of Opemiska Copper Mines showed an increase of slightly over $2-million in 1959. Gross value was $9-million from output of 28.5-million lb copper, 13,080 oz gold and 169,300 oz silver from 443,444 tons milled. Average milling rate was 1,215 tpd and this will be substantially higher this year following completion of mill expansion to 2,000 tpd in the final quarter of 1959.

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## BRITISH COLUMBIA

**Rexspar Minerals and Chemicals Ltd. plans to prepare a feasibility report** on its Birch Island mineral and chemical property in order to obtain production finances. It also plans to extend its fluorspar deposit and complete its metallurgical program. It will set up a pilot plant with aerial tramway from mine to millsite to bring its fluorspar mine into ultimate operation.

**Pato Consolidated Gold Dredging Ltd. estimates 1959 net profit at $550,000** or 16 cents a share, according to a preliminary report to shareholders. Gold production totalled 102,868 oz, a drop of 19,422 oz from 1958. All dredges operated normally throughout the year. In the final three months of 1959 gold production was 27,979 oz compared with 26,218 in 1958.

**Reeves MacDonald Ltd. reported more than 10-fold increase in net profit** to $69,399 in 1959 at its annual meeting this month. Work on the new orebody indicated ore of a similar grade to that mined by the company in previous years. Production in 1959 was 421,593 tons, compared with 417,076 tons in 1958. "Purchase of zinc concentrates by Consolidated Mining and Smelting is solving the company's transportation costs," said president Jens Jensen.

**Cowichan Copper Co. Ltd. has completed loading its ninth cargo of copper concentrate for Japan.** The cargo contained 500 tons of copper valued at about $320,000. Production has increased to 400 tpd. "We are getting into a current position and we're hitting our exploration hard, as well as stepping up production," said O. G. MacDonald, company president.

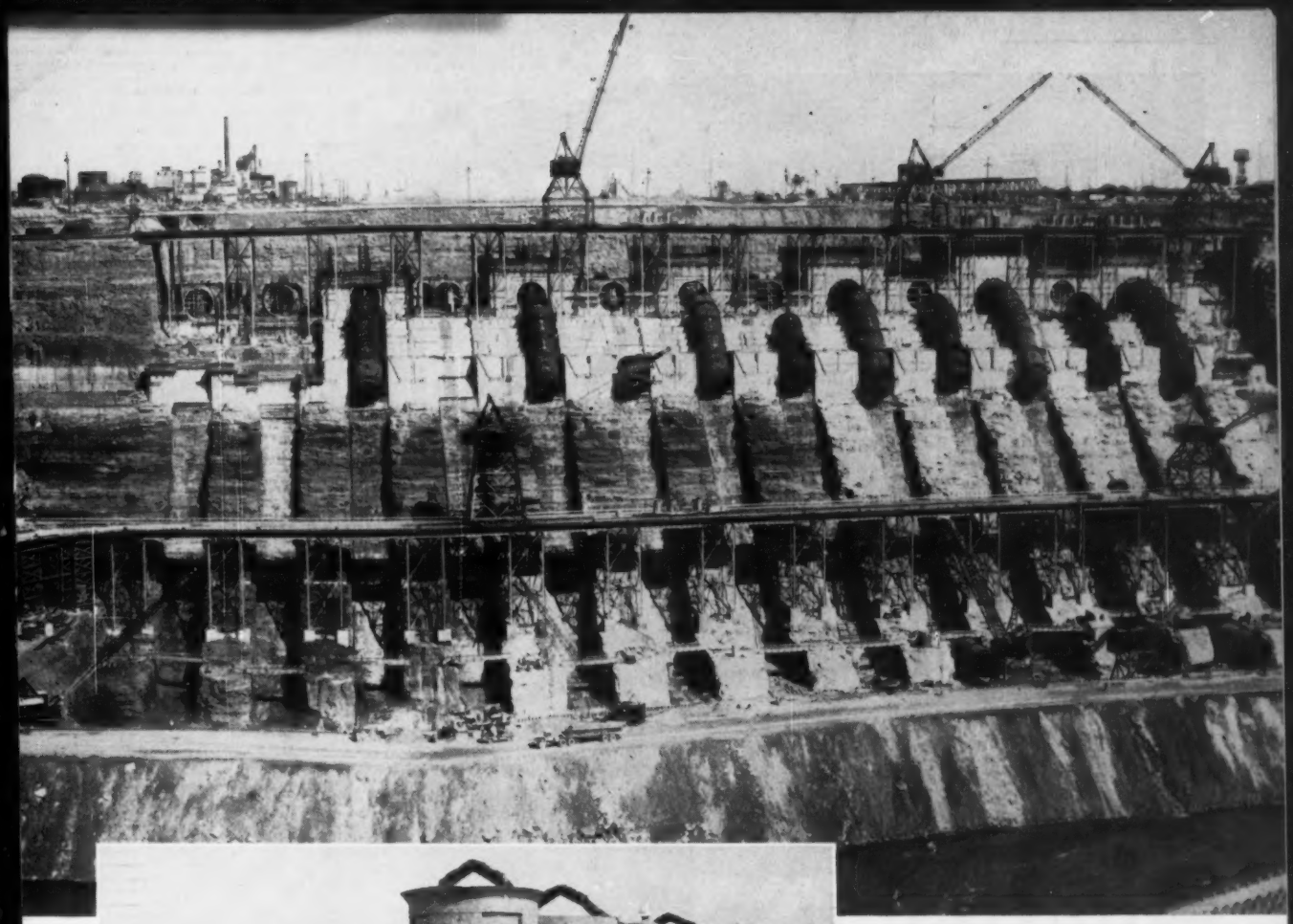
**Howe Sound Co. Ltd. is carrying forward its exploration program at Britannia Mines,** but so far has encountered no new deposit of ore. Mining has extended four miles leaving four miles to the open end. Present program calls for completing one mile underground, and 800 to 900 feet diamond drilled laterally north and south. No economic ore has been found.

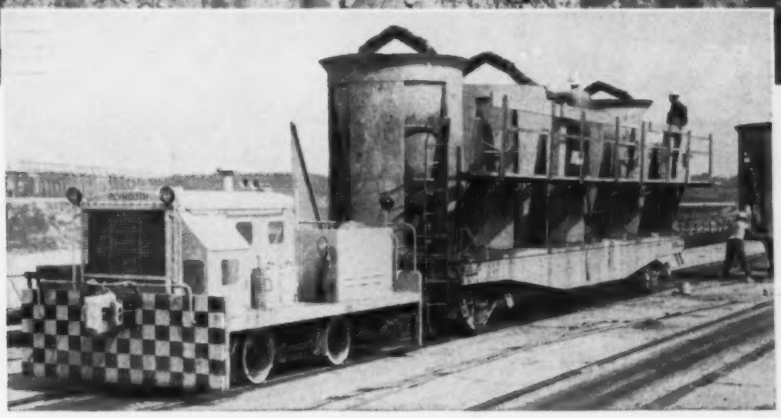
**Highland-Bell Ltd. reports gross 1959 revenue** from Beaverdell mine was $842,065. Outside prospecting continues, particularly with others in prospecting syndicates, Karl J. Springer, company president, said in the annual report.

**A 17-ft intersection in good copper mineralization,** 150 ft below the surface, has been made by Torwest Resources Ltd. at its Aberdeen property. Ron Renshaw, mine manager, estimated ore will run 5 to 6% copper. The drilling was to test the west contact following good surface indication.

**Sherritt-Lee Mines Ltd., a new mining company, is raising money** to develop the old Silver Bounty property on Wallace Mountain at Beaverdell, adjoining Highland-Bell.

*(Continued on p 388)*





**Main Generating Plant—Niagara Power Project—Lewiston, New York**

*Like a massive stage setting, viewed from the Canadian side, is the Main Generating Plant of the Niagara Power Project of the Power Authority of the State of New York. Located five miles below Niagara Falls, this power project will harness the full potential of the United States share of Niagara Falls. When completed, it will produce 1,950,000 KW of electrical power.*

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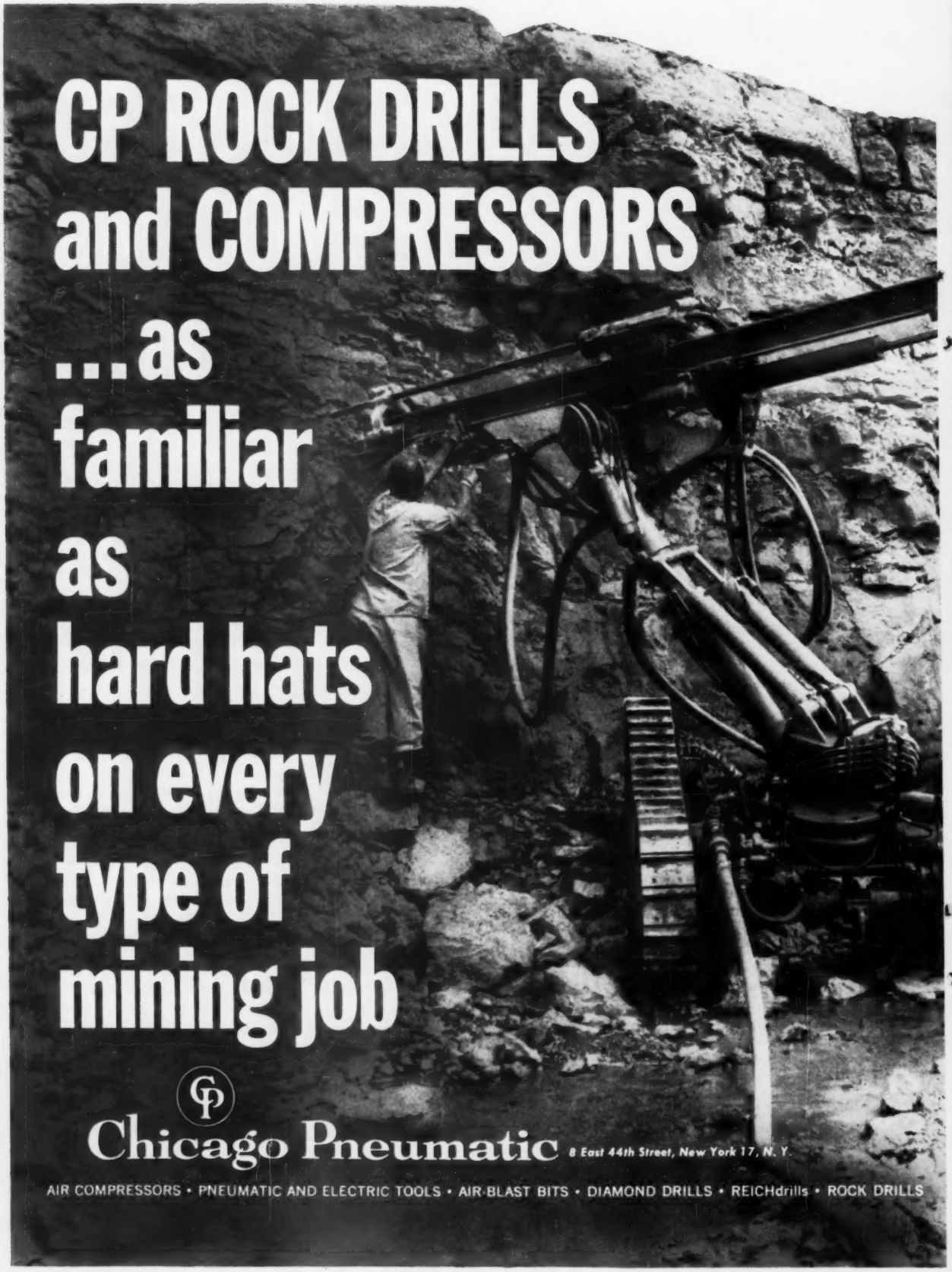
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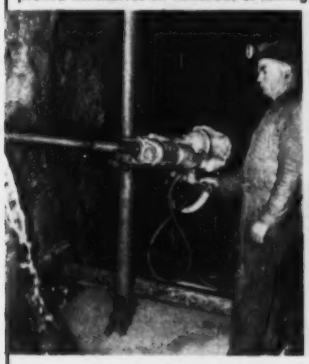

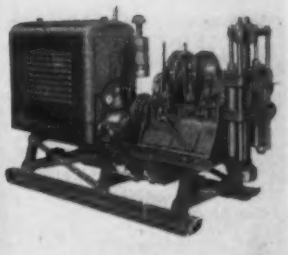

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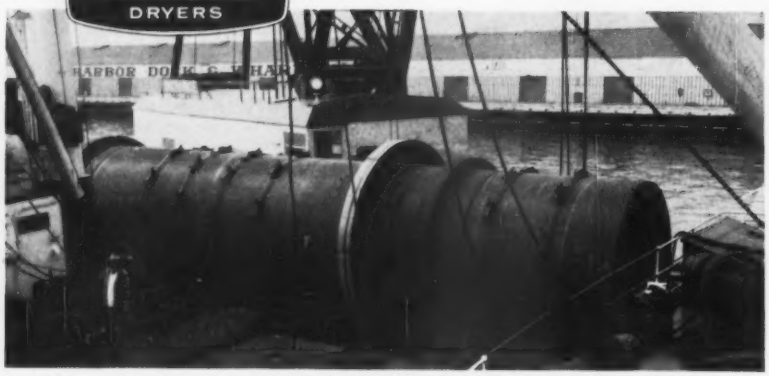

## Huge Dryer Goes To Chile Exploration Co.

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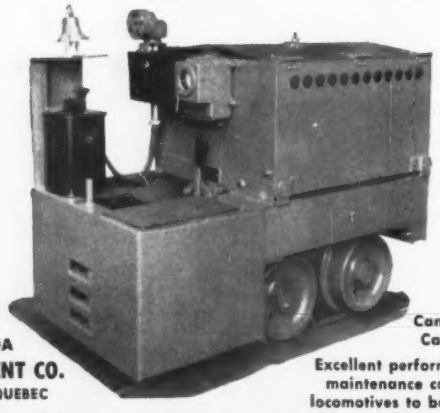

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## B. C. *(Continued)*

**Giant Nickel Mines Ltd. is on a solid producing basis** on a three-year contract with Sumitomo Metal Mining Co. of Japan. Price is 50c a lb for nickel plus payment at market for the small copper content. Giant Nickel's two main orebodies, the Brunswick and the Pride of Emory, have 950,000 tons reserve with grade estimated at 1.18% nickel and 0.30% copper. Production, now 20,000 tons a month, will rise to 23,000 tons shortly. Bulk concentrates, containing 10% nickel and a small quantity of copper, are being trucked to Vancouver. First cargo, between 3,000 and 3,800 tons, will be shipped May 10.

**"Pioneer Mine is a marginal operation and soon may be closed down,"** Franc R. Joubin, president Bralorne Pioneer Mines Ltd., said at the annual meeting. Even if new ore is established at a lower level it is probable actual development and production could best be handled by extending the existing deep workings of Bralorne into the Pioneer ore. (Bottom workings of Pioneer are about 2,000 ft above bottom workings of Bralorne.) The company began work in April on a mercury prospect and a gold-base metal prospect, both located in the Omineca district. This is a joint venture with Noranda and Canax. Work is also being done on the Ace property, a surface showing of gold and antimony in the Bridge River area. About $100,000 was budgeted for exploration this year.

**Net profit of $32,226, or 7¢ a share,** was reported by Granby Mining Co. Ltd. compared with a 1958 loss of $3,757. Phoenix Copper Ltd., Granby's wholly-owned subsidiary, started operations in April 1959 and made an operating profit of $161,958 before depreciation and depletion. Mill capacity was increased from 679 tons to 1,000 tpd at the beginning of 1960. Mine reserves at Phoenix mine are estimated sufficient for four years' production. A loan of $200,000 to Western Nickel was repaid early last year, and Western Nickel bought equipment Granby had placed in its property on a rental-purchase contract. Exploration will continue this year.

**A loan of $200,000 is being arranged by Cariboo Gold Quartz Mining Co. Ltd.** to assist in development of the new Burnett fault at the company's mine near Wells. Extent of the ore must be determined by getting above and below the 3,000-ft level. Since January 10,400 tons of ore were mined, realizing 4,916 oz and grading 0.49%, highest grade in several years. In the new fault 350 tons had graded 0.75%.

**An option has been given to Consolidated Mining and Smelting Co. Ltd.** to buy a 90% interest in a copper-iron prospect in south-central B.C. It consists of a group of 36 claims near Tulameen held by Bethlehem Copper Corp. Ltd. The claims surround a Cominco property on which no work has been done. Initial payment of $1,500 has been made and a similar sum will be paid on April 1961. Thereafter the

# Where DEPENDABILITY counts in centrifugal pumps...

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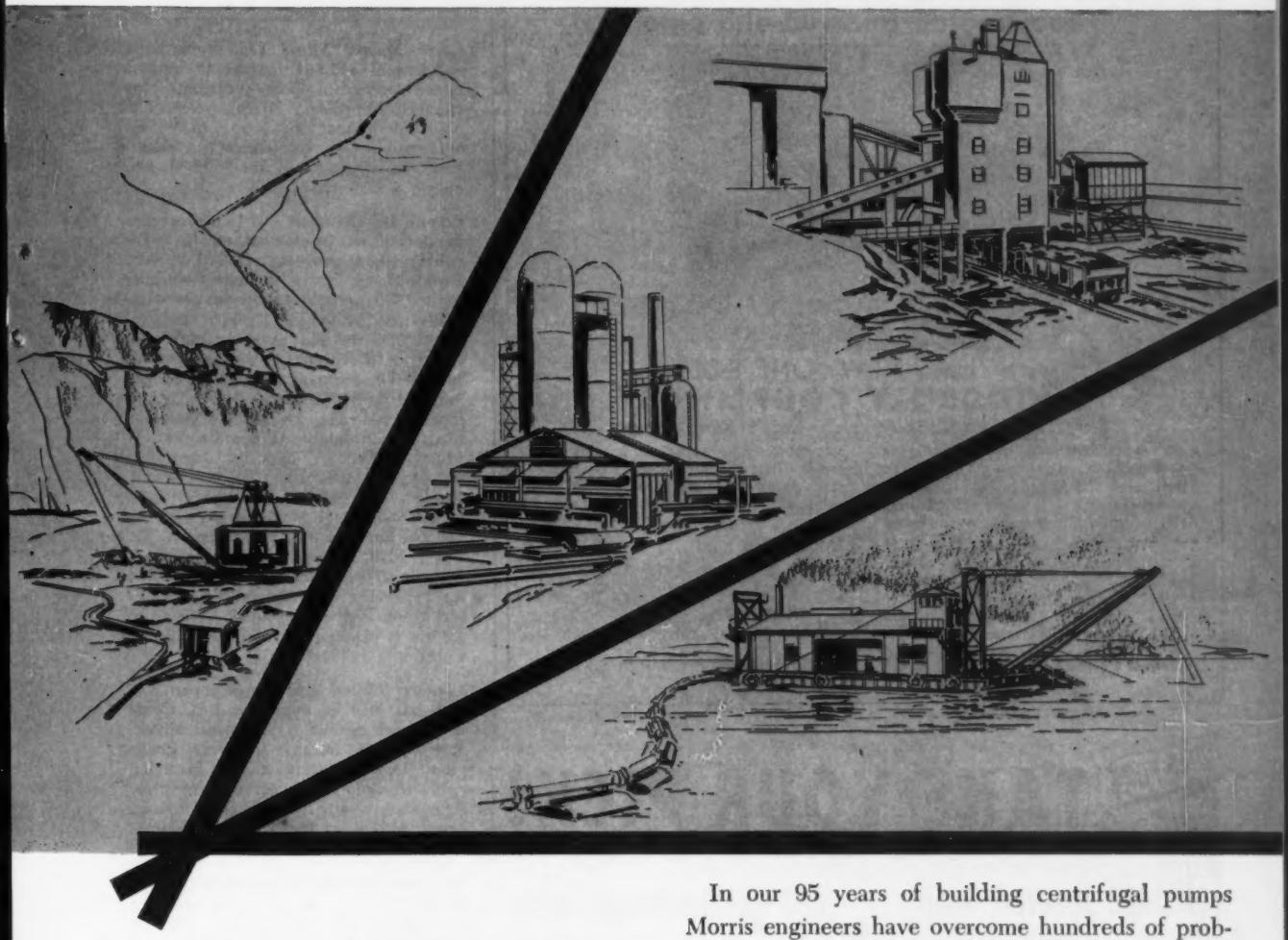

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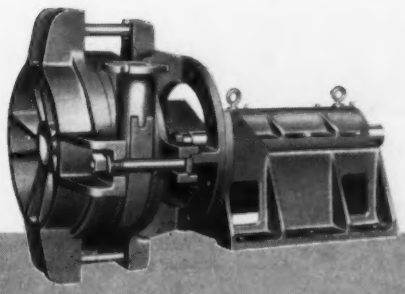

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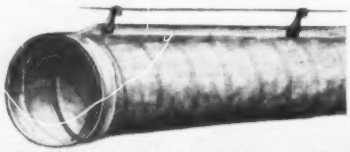

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## B. C. *(Continued)*

yearly payments will increase to $2,000 until April 1970. Cominco can withdraw from the transaction at any time.

**Giant Mascot Mines Ltd., reported a net loss of $52,801** for the 15 months ended December 1959, (year end was changed from Sept. 30 this year). The company granted an option to W. R. Wheeler to buy its interest in Nighthawk Gold Mines Ltd. for $30,000. The option was exercised Feb. 15.

**Empire Development Co. Ltd. succeeded in having its assessment on its Vancouver Island property reduced** by Mr. Justice T. G. Norris in Supreme Court of B.C. The property was assessed originally for $1,543,663, which was reduced 30% by the assessor. Later the Court of Revision cut the assessment in half. The company claimed the 8% tax imposed by the province's Mineral Property Taxation Act on existing valuation made it unprofitable to operate. Texada Mines Ltd. also had its assessment reduced on six properties on Texada Island. Its original assessment was $1,630,654, which was reduced 10% by the assessor and 30% by Court of Revision. Justice Norris reduced the assessment to $79,250 for 1958 and $121,250 for 1959. The ore from both operations was being shipped to Japan. Validity of the act is pending judgment of Supreme Court in Canada.

**Contact Mining and Development Co. Ltd. has filed an appeal in B.C. Court of Appeal against a judgment** of Mr. Justice A. E. Lord in favor of Craigmont Mines Ltd. in a suit involving rights to claims. Contact claimed prior right on a number of claims in Crown Lease No. 1 at the Craigmont Highland Valley property.

**An expenditure of $4-million is planned at Kitimat** over the next two years to proceed "on an orderly basis" with the construction of buildings which will eventually house 80,000 tons per year capacity, according to Nathanael V. Davis, president of Aluminum, Ltd.

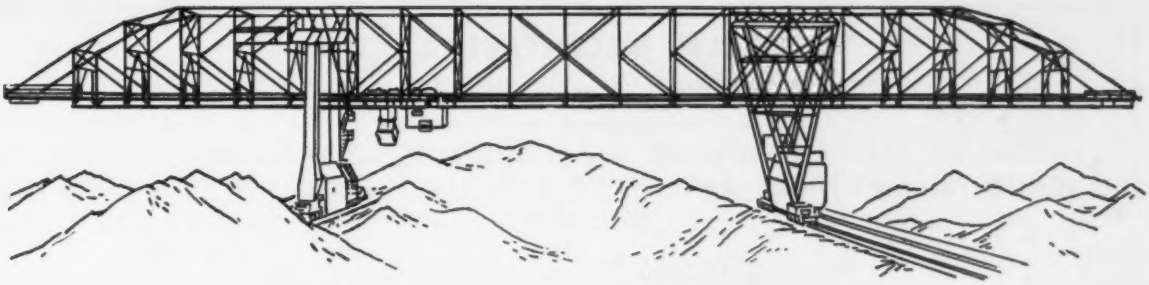
Construction of the buildings, Davis noted in his report to stockholders, was halted in 1957, "The program," he said, "does not yet involve installation of machinery and equipment."

The $4-million is part of some $6.5 million, allocated recently for improvements at Alcans smelters at Arvida, Kitimat and Isle Maligne "to round out the company's ability to meet the needs of world buyers of aluminum ingot products."

## IN AUSTRALIA

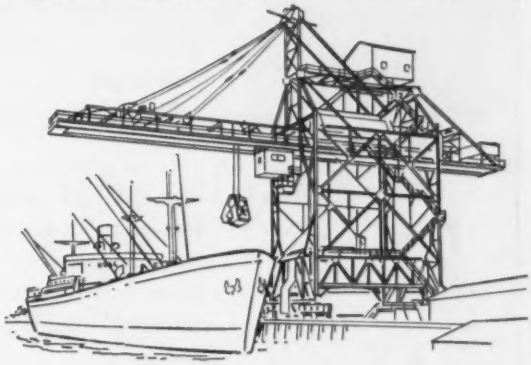
**Australian Federal authorities are determined not to grant any further subsidies** to the gold mining industry. The "ailing industry" is expected to continue its output at or around present levels of production.

**South Alligator Uranium N.L.'s half-year** (ended March 19) operating profit

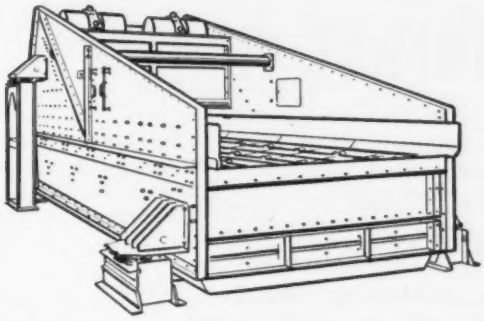


ore and coal bridges

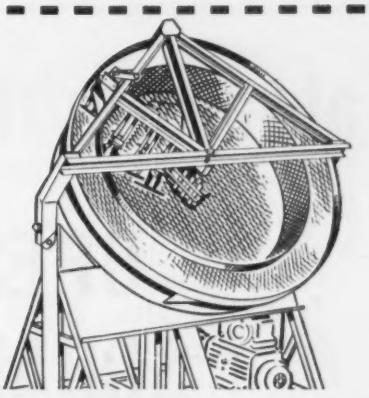
coal unloaders



ship unloaders



vibrating screens & conveyors



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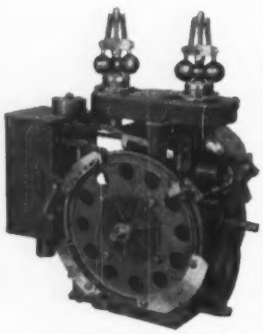

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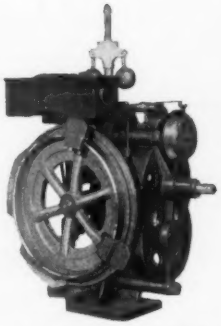

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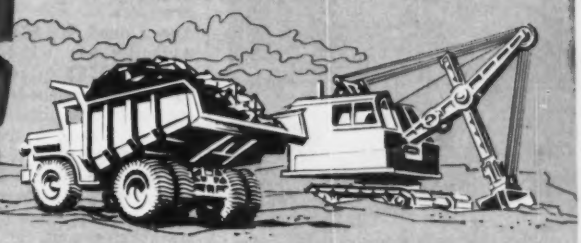

The Power Lug Earthmover is built to absorb the greatest stress punishment—whether the stress comes from the weight of the load, from the grind of road friction, from the pounding of rocks or the ripping forces of turns.

*Flexibility* is the secret, achieved through the new Seiberling tread curvature design, *low angle lugs*. These lugs, linked by a free-floating center support, can take more twisting, pounding and snagging than lugs of conventional design. And they have a greater bearing surface, giving you higher flotation, better load distribution, increased road contact, more traction.

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The Power Lug Earthmover has many other features for maximum service under every road and load condition. Get complete details from your Seiberling dealer, or contact Truck Tire Department, Seiberling Rubber Company, Akron 9, Ohio.

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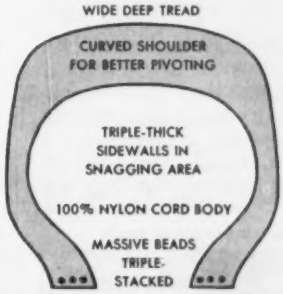
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## Australia *(Continued)*

was £A150,040. The new No. 1 level drive to test for a continuation of the Rockhole ore zone is now in high-grade pitchblende ore and it is hoped about 1,000 ft of potential orebearing ground is ahead of the new drive. Ore milled to date has averaged 1.03% uranium oxide with a mill recovery of 93%.

**United Uranium N.L.'s profit for the year ended December 31** was £A233,960, which was derived from eight months' treatment operations. More than one-half of the export quota for 1960 was ready in April 1960. Recent exploration results have been described as very encouraging. The company is working on a long-term contract with the U.K. Atomic Energy Authority. An iron ore deposit in Collie, Western Australia, will not be exploited because recent investigation disclosed only 30% assay of metallic iron.

**It was reported in Melbourne that Pacific Islands Mines Ltd.** reports an extensive new lode system with promising gold values at Misima Island, Papua. A pilot plant is being planned for this new area.

**The United Kingdom Atomic Energy Authority has withdrawn the offer it made in 1957 to buy annually in the Federation of Rhodesia and Nyasaland chemical concentrates containing 500 tons of uranium oxide.** It has also amended the offer to buy quantities of contained $U_3O_8$ in uranium-bearing ores produced in the Federation, while still preserving the rights of holders of existing workings and, for a reduced period, those of the holders of existing unworked claims. The maximum quantity of contained $U_3O_8$ that the Authority will buy in a year has been reduced from 100 to 20 tons.

**Mineral production in Northern Rhodesia during March 1960 was provisionally valued at $31,914,372,** compared with $33,202,680 during the corresponding month in 1959.

This total included 14,725 tons of blister copper valued at an estimated $8,592,052, 33,803 tons electrolytic copper ($21,179,592), 3,756 cwt cobalt ($618,436), 1,203 tons lead ($257,040), 4,488 tons manganese ore ($149,828) and 2,584 tons zinc ($652,428).

**The value of mineral production in Southern Rhodesia in the first quarter of this year was $17,194,800,** compared with $16,324,000 in the same period last year.

Copper production in Southern Rhodesia continues to rise. The value of output in the first quarter was $1,537,200 —an increase of $677,600 over the previous year.

The value of coal production was also up, from $2,396,800 to $2,570,400, reflecting increases in both price and output.

Chrome production in the first quarter of 1960 was 156,000 tons, valued at $2,354,800, compared with 134,000 tons valued at $2,150,400 in the same period the previous year.

Although asbestos output increased in the first quarter of this year over the figure for the same period last year, the value of this commodity dropped from $5,171,600 to $4,956,000. Production figures were 29,000 tons and 33,000 tons respectively.

At $4,766,496, the value of gold production also showed a slight decrease in the first quarter against the period January to March, 1959.

**The prospect of two new mines south of the Vaal River on the Transvaal-Orange Free State border has been dimmed somewhat** by the announcement in the Western Holdings report of poor value for borehole No. 9 drilled in the southern corner of the farm Pretorius Kraal.

Western Holdings—a producing mine in the Anglo-American group—states in a report that two new boreholes will be drilled on Pretorius Kraal. But both these holes lie within the established zone of apparent payability.

## IN AFRICA

**Feralloys Ltd., at Cato Ridge, Natal, a company owned by Anglo American, has installed two furnaces** with a combined capacity of 20 tons of ferromanganese every three hours under normal working conditions.

**At the Chimbuluma West copper mine in Northern Rhodesia shafts are now being sunk** as part of a £600,000 ($1.6-million) program to develop some 2-million tons of copper ore in the area containing 4.74% copper and 0.05% cobalt. A rock-surface shaft has already been sunk over 200 ft and a ventilation shaft about 125 ft. This expansion should be completed by 1963 and, utilizing surplus plant capacity, should increase Chimbuluma's copper production by about 4,000 long tons annually.

**Bikita Minerals (Pvt.) Limited, a lithium producer with large deposits in the Bikita district** of Southern Rhodesia, will not be placed on a care-and-maintenance basis as has been previously reported in Africa. On the contrary, the mine will be worked as before and added production will come from adjoining mineral claims.

**A $12-million expansion and development project to include the installation of an imperial smelting furnace process is to be undertaken** by the Rhodesia Broken Hill Development Co. at Broken Hill, Northern Rhodesia. The new process will improve the recovery of lead and zinc from currently mined ore from about 60% to more than 85%, and will enable about 200,000 long tons of lead and zinc to be recovered from products at the mine which at present cannot be treated economically.

**Production of gold in the Union fell from 1,714,107 oz in February to 1,703,258 oz in March.** The loss of production due to power cuts arising from shut-down troubles at the Coalbrook disaster mine in the Orange Free

State is estimated at 83,000 oz in March. But for this loss it would have been an excellent month; as it was, the mines produced 109,791 oz in excess of the March 1959 total.

**Despite the loss of production in March, the gold output for the three months, January-March, was a record** for the first quarter of any year in mining history. The quarterly total was 5,153,126 oz, compared with 4,646,360 oz in the first quarter of 1959.

But for the loss of output in March it would have comfortably beaten the previous record for any quarter, set in July-September last year with a figure of 5,222,548 oz. The value of gold produced in this first quarter of 1960 was £64,400,000 ($178.2-million).

**If payable reefs are disclosed by underground drilling in the Freddies Consolidated lease area, considerable time and expenditure will be required** to complete the development required for exploitation of the area, the directors state.

Freddies is one of the mines on the Orange Free State Goldfields belonging to the Johannesburg Consolidated Investment group.

It is hoped that production can soon be increased to levels which will eliminate working losses and restore mining operations to a break-even basis. But if the current program does not eliminate the losses by the middle of this year it will probably be necessary as a first step to curtail development further so as to lower working costs.

This would inevitably lead in due course to a progressive reduction in the scale of mining. And in current circumstances this would be a likely prelude to the suspension of mining operations.

The choice would then be between shutting down the mine and disposing of the assets or putting it on a care and maintenance basis.

**The main feature of the layout of a modern gold mine like Western Deep Levels**—the Anglo-American mine now being developed on the Far West Witwatersrand—should be boldness and low overhead service costs. This is typical of the mines whose life will in the end be fixed by depth of working.

This point was made by F. G. Hill, a prominent mine technical manager and consulting engineer in an article in the Anglo-American journal OPTIMA.

If the plans of the present team of engineers are implemented they will exhibit both these features, thus aiding the mine considerably in its last days at depths of possibly 14,500 to 15,000 ft. Mr. Hill points out that it is the broad initial master plan that will largely determine the overhead costs with which the mine will be saddled in its later days.

Much thought has been given to future pressure problems at Western Deep Levels. To guard against water that may build up in Blyvooruitzicht and West Driefontein—the mine's two neighbors—when they cease operations, the engineers plan to leave a 1,000 ft wide pillar along the whole northern boundary. The normal legal requirement for such a pillar would be 60 ft.

## Personals *(Continued)*

**Harry F. Brown,** general manager of Du Pont's Explosives Dept., will retire after a 43-year career with the company. **Charles Brelsford McCoy** has been named to succeed him.

**William C. Kay,** general manager of the Organic Chemicals Dept., will take Mr. McCoy's place as general manager of the Elastomer Chemicals Dept.

**Glen C. Taylor** is the new manager of the Apex, Nev., operation of Fibreboard Paper Products Corp.'s gypsum division. **J. M. Hogue** is stepping into the position of plant manager of the South Gate gypsum plant.

**Dr. D. R. Derry** has resigned as vice president and director of Rio Tinto Mining Co. of Canada Ltd. in order to conduct independent consulting practice.

Dr. Derry, who has been in charge of Rio Tinto's Canadian exploration from its early days, will continue in active association with the company as well as with Rio Tinto Co. of London.

**J. Arthur Sadler,** vice president of Rio Tinto Canadian Exploration Ltd., succeeds Dr. Derry.

**Stanley M. Secrist** has been reappointed to the Arizona Department of Minerals Resources board of governors. He originally was named in 1951 and was reappointed in 1955. His new term extends to Jan. 31, 1965.

**R. W. Grosz** has been appointed manager of the southern district of Quebec Cartier Mining Co. Managing the northern district will be **V. R. Huff.**

**George D. Weaver,** former smelter and refining superintendent at Whilte Pine Copper Co., is now general superintendent of surface operations. Succeeding Weaver is former assistant superintendent **F. B. Wercinski.**

Other personnel changes at White Pine include the appointments of **L. A. Garfield** as general mine superintendent; **Harold Raymond,** assistant general mine superintendent; **M. P. Trainor** and **Leo Kauss,** superintendents of the two subdivisions of underground operations; and **Carl Bailry,** maintenance superintendent in the mine division.

**Clarence L. Eckel,** dean of the University of Colorado College of Engineering since 1943, will retire June 30.

Mr. Eckel has been on the University of Colorado engineering faculty since 1914. He plans to spend a year or two as a visiting lecturer at a California college.

**Bernard W. Bernstrom,** formerly chief mechanical engineer for Pickands, Mather & Co., has joined Jones & Laughlin Steel Corp.'s Engineering Dept. as raw materials engineer.

**Thomas E. Congdon** and **Willliam J. Carey** have established a joint mining exploration and investment program.

Congdon, who will direct the program in the Rocky Mountain states, has been


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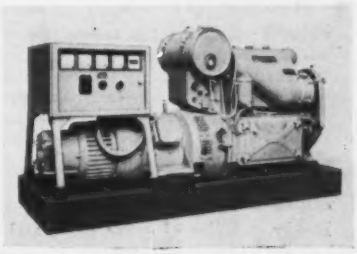

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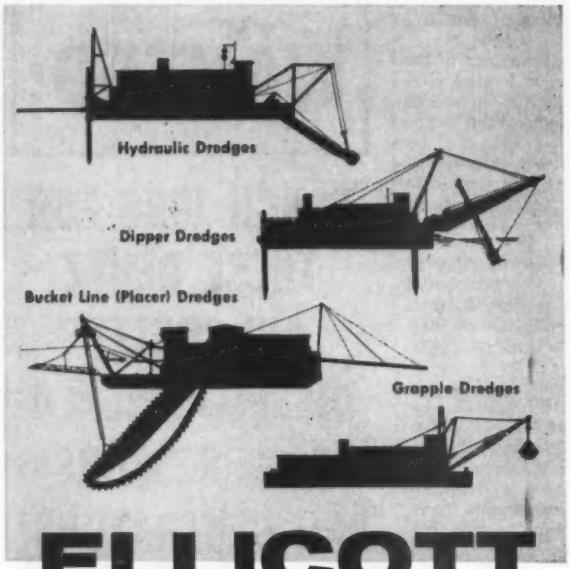


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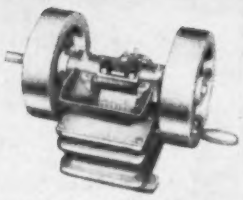
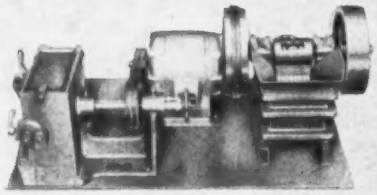


2¼" x 3½" Jaw Crusher for hand or power drive

5" x 6" Jaw Crusher, capacity 2000 lbs. per hour



4" x 6" Jaw Crusher in combination with 8" disc pulverizer

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## RODS FOR MANUAL APPLICATION

| This Hardfacing Rod | For These Conditions | This Equipment or use | How Applied |
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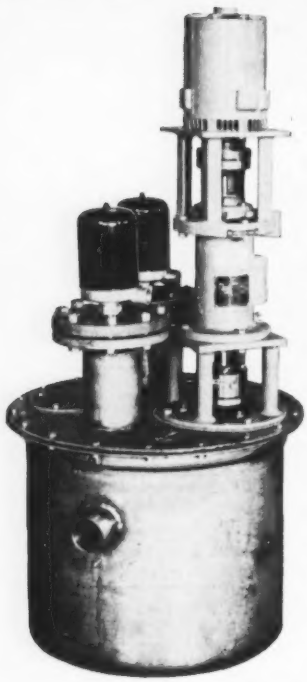
| **VICTORTUBE** (Tungsten Carbide) | Severest abrasion | Earth cutting, scraping, drilling tools, rippers, augers, ditchers, excavators, loaders | Gas AC-DC Arc |
| **VICTORTUBE (TC)** Bare 30-Down | Severest abrasion; moderate impact | Agricultural and earthworking tools. Suitable for acetylene application | Gas only |
| **VICTORTUBE "SPECIAL"** (Tungsten Carbide) | Severe abrasion with impact | Oil field tools - rock bits, drag bits, reamers; water well drilling tools | Gas only |
| **VICTOR TUNGSMOOTH** (Tungsten Carbide) | Maximum abrasion | Edged cutting tools - bits, blades, farm tools. Smooth, thin deposits on augers, screw flights, paddles. | Gas AC-DC Arc |
| **VICTORITE** | High abrasion; sliding friction | Earthmoving and agricultural tools, brick augers, conveyors, mill guides | Gas AC-DC Arc |
| **TUBE VICTORITE** | Abrasion and impact | Farm tools, crushers, grinders, mixers, scrapers, fan and screw conveyors | Gas AC-DC Arc |
| **VICTORITE 1** | Heat; abrasion, corrosion | Chemical & food machinery, cement pumps, brick dies, dry bearings & journals, expellers | Gas AC-DC Arc |
| **VICTORITE 6** | Heat; impact; corrosion; abrasion | Hot dies, stripper bits, exhaust valves & seats, dry bearings & journals, edging rolls, cams | Gas AC-DC Arc |
| **VICTORITE 12** | Heat; corrosion; abrasion; impact | Saw-blade inserts, shaft bearings, hot punches, flapper valves, needle valves | Gas AC-DC Arc |
| **VICTORITE** CARBON ARC | High abrasion; sliding friction | Farm tools, earth abrasion. Applied by gas. Deposits are exceptionally smooth. | Carbon Arc Gas |
| **VICTORITE** Plow Point Bar | High abrasion; sliding friction | Cast-to-shape, weld-on cutting edge for plow shares, digger teeth, pilot bits | Gas |
| **VICTORALLOY** | Severe impact; abrasion | Crusher & dredge parts, tamper feet, bucket teeth. A tough low-cost hardfacing. | Gas AC-DC Arc |
| **VICTORALLOY #1** | High abrasion; medium impact | Crushers, bucket lips & teeth, muller tires, dozer blades, dredge pumps | Gas AC-DC Arc |
| **VICTORALLOY "A"** | Angular shock; extreme impact | Clutch parts, gears, latches, pins & keepers; build-up for hardfacing | AC-DC Arc only |
| **VICTORALLOY "B"** | Heavy impact; moderate abrasion | Tractor idlers, sprockets, rolls, crusher parts, pump casings, impellers, liners | AC-DC Arc only |
| **VICTORALLOY "C"** | High abrasion; moderate impact | Cement screws, gudgeons, drag chains, pressure rolls, mixer blades & paddles | AC-DC Arc only |
| **VICTOR MULTI-PASS** (for Build-Up) | Severe impact; compression | Drill tools, crawler pads, crushers, mine rails; build-up for hardfacing | AC-DC Arc only |
| **VICTOR Ni-Mn** (for Build-Up) | Severe impact; compression | Hardmetal underbase for manganese steel parts on crushers, dredges, dippers | AC-DC Arc only |
| **VICTOR Ni-Mn** (for Attachment) | Severe impact | A low-cost "stainless" joining rod for crushers, dippers, crawlers, dredges | AC-DC Arc only |

## WIRES FOR AUTOMATIC & SEMI-AUTOMATIC APPLICATION

| This Wire | For These Conditions | This equipment or use |
|---|---|---|
| **VA O** | Severe abrasion; moderate impact | Crushers of all types, tool joints, mullers |
| **VA 1X** | Abrasion & compression with impact | Scrapers, bucket teeth, crushers |
| **VA 2X** | Severe compression & impact with abrasion | Steel mill rolls, dredge rolls, cable sheaves |
| **VA 3** | Severe abrasion & compression with impact | Mill guides, crushers, grinders |
| **VA 4X** | Severe impact & compression | Build-up on trunnions, tractor idlers & tracks |
| **VA 5X** | Severe metal-to-metal impact & abrasion | Shovel rollers, tractor rollers & idlers |
| **VA 6X** | Severe impact, high temp., dry bearing | Steel mill rolls, clutches, roll necks |
| **VA 7X** | Severe impact & compression with abrasion | Build-up on mine car wheels & tractor rollers |
| **VA 8X** | Earthworking abrasion & impact | Dozer blades, scraper blades, tool joints |
| **VA 10** | Extremely severe abrasion; moderate impact | Tool joints, crushers, scrapers, swing hammers |
| **VT 60** (Tungsten Carbide) | Maximum abrasion; earth cutting, scraping | Tool joints, scraper blades, augers |
| **Ni-Mn** (Hadfield) | Wear, all types manganese steels | Build-up manganese steel parts for overlay or to size |

# Nagle Pumps for the Atomic Age



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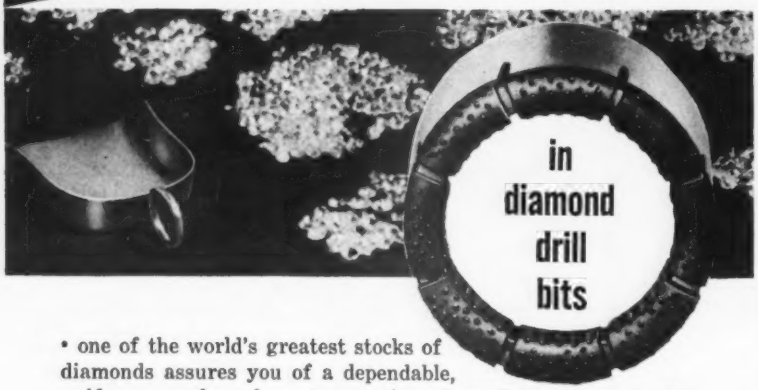


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## Personals *(Continued)*

financial manager and assistant to the vice president of Western Operations for Climax Molybdenum Co.

Carey has been active in the mining business since 1954, operating as William J. Carey Mining Co.

**Harry E. Haynes** will serve in an advisory capacity to the new venture. Geologist in charge of the program is **Dolf W. Fieldman,** formerly associated with Anaconda Co., U.S. Bureau of Mines, U. S. Geological Survey, American Zinc, Lead & Smelting Co., and Eagle-Picher Co.

**Jean Vuillequez,** American Metal Climax Inc. vice president, was elected president and chairman of the board of directors of the Lead Industries Assn. at the 32nd annual meeting last month.

**Joseph A. Costello,** Ethyl Corp. vice president, **Charles R. Ince,** St. Joseph Lead Co. vice president, and **Simon D. Strauss,** American Smelting & Refining Co. vice president, were elected vice presidents.

**Robert L. Ziegfeld** continues as secretary-treasurer.

Two new directors, **Harold E. Lee,** Bunker Hill Co. vice president, and **C. G. Rice,** U.S. Smelting, Refining & Mining Co. executive vice president, were elected to fill vacancies on the board. All other directors were reelected.

The following were appointed to the executive committee: Andrew Fletcher, J. A. Martino, C. G. Rice, S. D. Strauss, Costello and Chairman Vuillequez.

**Henry J. Long** is now general manager of the MICA mine and milling facilities at Cordova, N.M.

He joins the Clute Corp. with a total of 20 years experience in mining and mineral processing; 13 years having been spent in the mica industry.

Long will supervise the Clute mill recently completed at the minesite and the company's fine grinding plant located near Pojaque, N.M.

The AIME Metallurgical Society has named the following new division chairmen:

Institute of Metals Div.: **Dr. Thomas A. Read,** head, Mining & Metallurgical Engineering, University of Illinois.

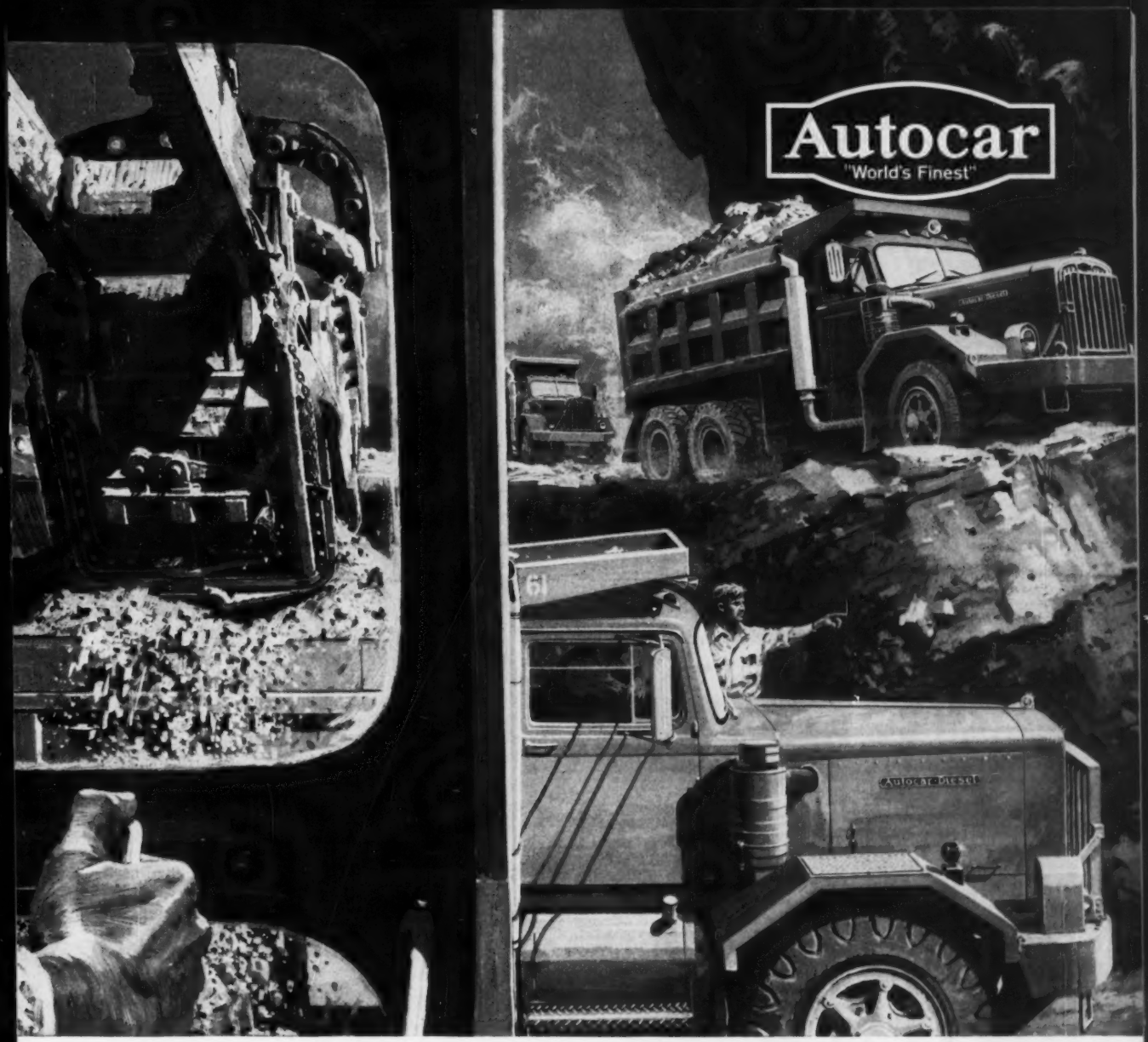
Extractive Metallurgy Div.: **Dr. Reinhardt Schuhmann, Jr.,** head, Metallurgical Engineering, Purdue University.

Iron & Steel Div.: **John J. Golden,** assistant to administrative vice president, Production Department, U.S. Steel Corp.

Twenty state program committee chairmen will help draft over-all plans for the 1960 Metal Mining & Industrial Minerals Convention & Exposition of the American Mining Congress to be held at Las Vegas, Oct. 10-13.

The state chairmen will assist national program committee chairman **Oscar A. Glaeser** in the development of a comprehensive program for this annual meeting of the entire industry.

Serving as state and district chairmen are: **Charles F. Herbert,** Alaska; **T. A. Snedden,** Arizona; **J. T. Watters,** Ar-

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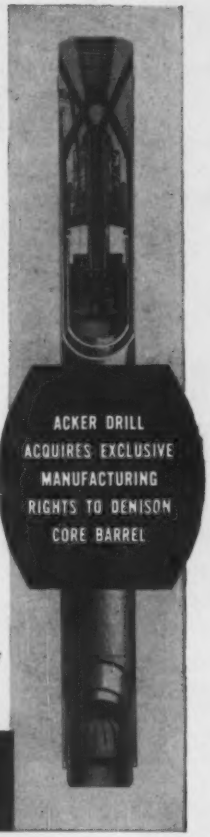


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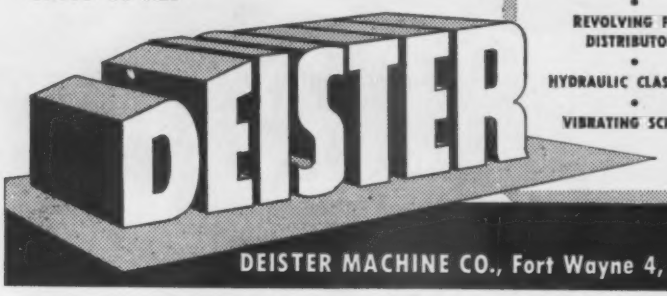


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## Personals *(Continued)*

kansas; **George F. Warren,** California; **Edwin H. Crabtree,** Colorado; **William H. Love,** Idaho; **E. D. Tierney,** Montana; **Joseph W. Wells,** Nevada; **M. F. Bolton,** New Mexico; **James H. McClain,** Oregon; **Claude E. Schmidt,** South Dakota; **W. P. Morris,** Texas; **Mitchell Melich,** Utah; **John Edgar,** Washington; **Lee C. Grenier,** Wyoming; **Gill Montgomery,** Mississippi Valley; **Harold A. Krueger,** Missouri - Kansas - Oklahoma; **Robert J. Linney,** Lake Superior; **H. Z. Stuart,** Eastern States; and **Albert E. Seep,** Manufacturers.

# New Patents

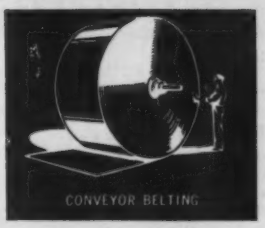
**In the separation and recovery of phosphate** and heavy mineral fractions from central Florida type phosphate ore, the rock is subjected to anionic-cationic flotation for the phosphate values, and tailing from the secondary flotation step is treated with a halogen and again subjected to froth flotation to recover the heavy minerals. D. H. Fenske, assigned to International Minerals & Chemical Corp. March 22, 1960. Canadian 594,-991.

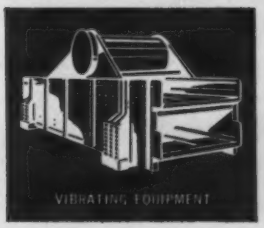
**In the formation of large, uniform pellets of iron oxide ores,** ore fines are mixed with a finely divided coking coal or the like having optimum softening and solidification properties. The mixture is tumbled in a rotating retort while being heated to about the softening temperature of the coal, whereby pellets are formed, compacted, rounded and hardened. C. E. Lesher, assigned to Lesher & Associates Inc. March 22, 1960. Canadian 594,819.

**In the preparation of high-purity metallic zinc** from zinc oxide ores, dross, skimmings or other oxide materials, the source material and a reducing agent are dispersed in a fused salt bath of at least one alkali metal halide salt, and the bath heated to an optimum temperature to vaporize the zinc, which is recovered from the effluent gases. J. L. Wyatt, assigned to Horizons Inc. March 15, 1960. Canadian 594,569-70.

**In the production of a high-grade hematitic iron product** from a sulphide ore containing iron, nickel, copper and cobalt, the ore is first beneficiated and concentrated to separate a clean iron sulphide fraction from the other metal values. This concentrate is roasted under oxidizing conditions and then selectively sulphated with sodium sulphate. The sulphated material is water leached to produce an uncontaminated iron oxide product. W. K. Sproule, P. E. Queneau and G. C. Nowlan, Jr., assigned to International Nickel Co. of Canada Ltd. March 1, 1960. Canadian 593,622.

**In a method for inhibiting the freezing of wet piles of ore,** a mixture of a major proportion of common salt and a minor proportion of an alkali metal iron cyanide, e.g. sodium ferrocyanide, is sprin-

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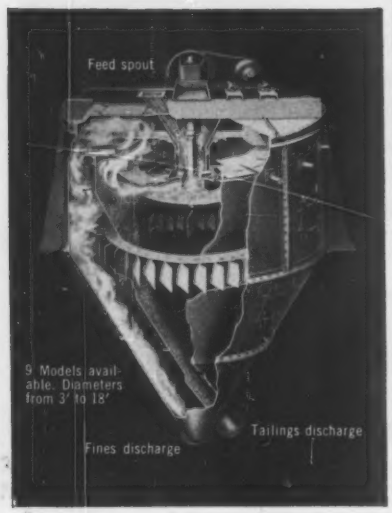


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## Patents (*Continued*)

kled onto or into the material to be protected from freezing. Addition of the cyanide substantially prevents caking of the pile, which might occur if common salt alone is used. D. W. Kaufmann, assigned to International Salt Co. March 8, 1960. Canadian 593,946.

**In an apparatus for the production of hard pellets of iron oxide ore,** the sinter grate bars are supported by hollow reinforced beams through which air or other cooling gas is forced, while the grate bars themselves are not directly cooled. A. Huber, assigned to Metallgesellschaft A.G. March 8, 1960. Canadian 593,953.

**In the fluidized bed roasting of iron sulphide ores** containing arsenic and/or antimony, the dust-laden roaster gases are subjected to a preliminary dust removal treatment at a temperature above 600° C., the remaining dust burned with oxygen-containing gases, and the gases cooled to 350-450° C. in a heat exchanger and subjected to electrical gas purification at the latter temperature. W. Pfannmueller, A. Johannsen, H. Wolf and G. Wittmann assigned to Badisch Anilin- & Soda-Fabrik A.G., March 15, 1960. Canadian 594,390.

**In a process for recovering chrysotile asbestos fiber** from weathered mill tailings, the tailing material is broken up and then subjected to drag classification in an aerated stream of water whereby a major portion of the fiber is floated and recovered. The underflow is then passed through a secondary drag classification step to increase the recovery of fiber. M. C. Pharo, assigned to Johnson's Co. Ltd. March 15, 1960. Canadian 594,471.

**Design for a combined electrostatic-magnetic separator** which is particularly adapted for use in the beneficiation of magnetic taconite or other magnetic type iron ores. Magnetic and non-magnetic materials are separately collected from the gases on collecting electrodes. Collecting the siliceous gangue, instead of venting it to the atmosphere, substantially reduces the silicosis danger in the mill. L. M. Roberts, assigned to Research-Cottrell Inc. March 22, 1960. Canadian 594,928.

**In the reduction of ilmenite,** the ore is first partially reduced in the solid state and the resulting mass then completely melted, forming two fluid beds, the lower being ferrous metal and the upper a slag rich in titanium dioxide. A. Greffe, assigned to Society d'Electro-Chimie Elictriques d'Ugene. No. 2,885,280.

**Method and apparatus** for controlling the density of a mixture of crushed nonferrous ore and water, using bubble pipes, arranged at a point in the pulp where the solids content is constantly representative of the entire mass. A. F. Kroll, K. E. Atwood and F. H. Mehle, assigned to Bailey Meter Co. No. 2,886,-051.

**Improved shock-chilling condenser** for


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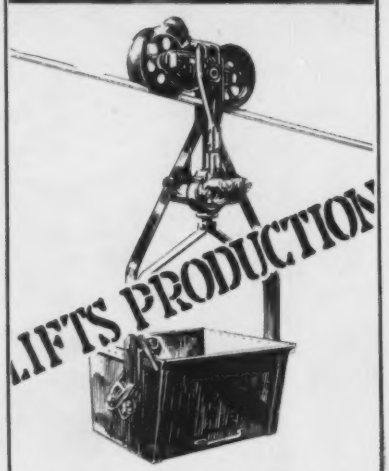


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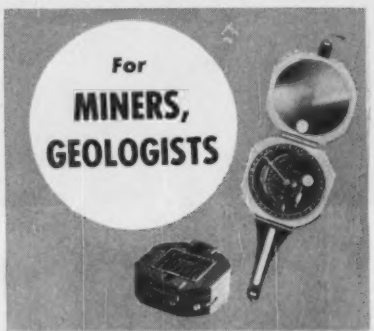


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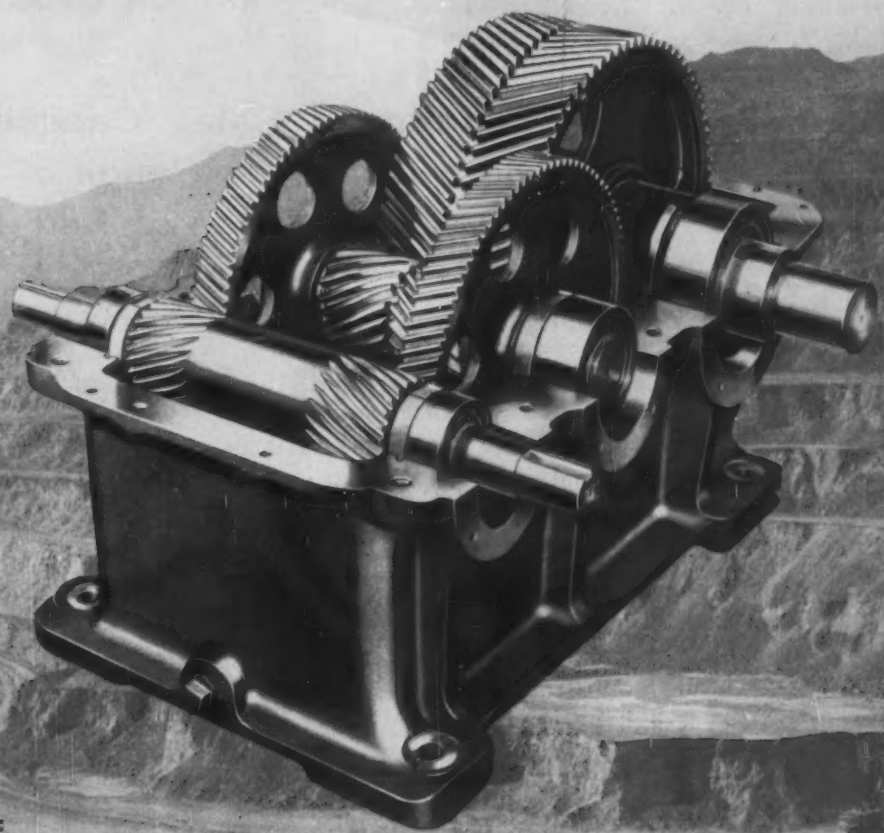

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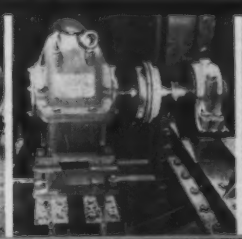

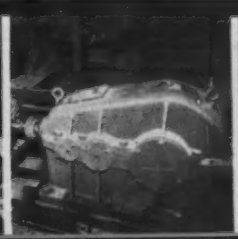

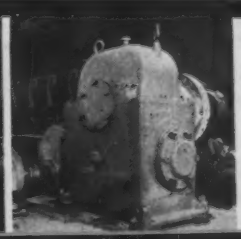

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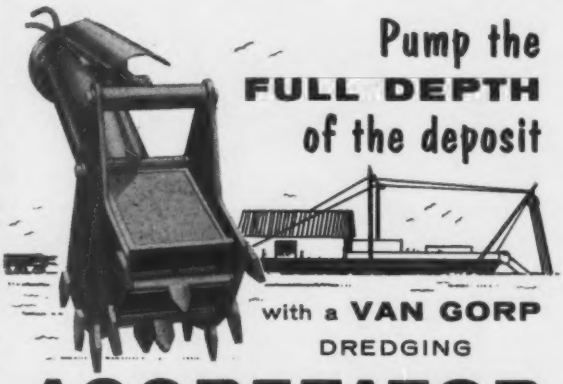

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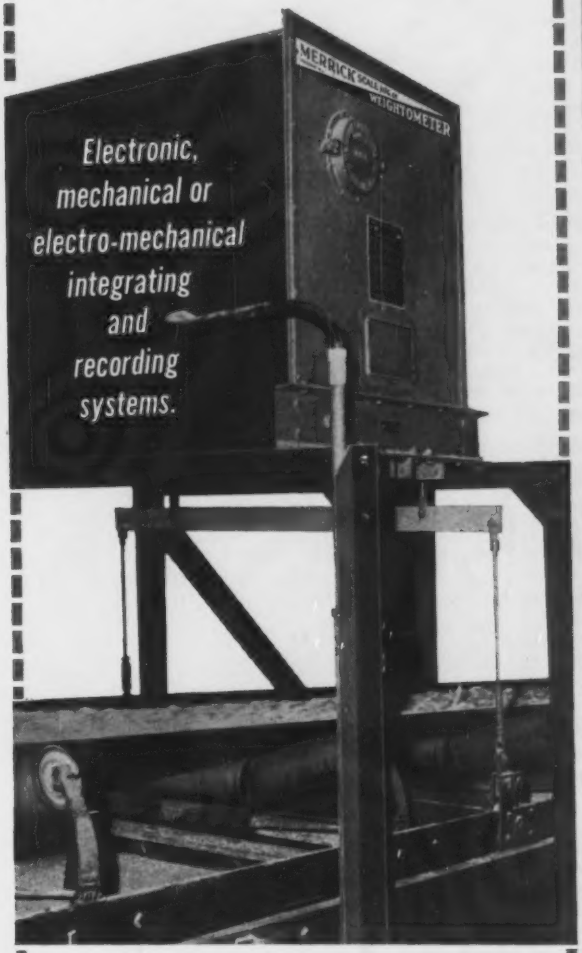


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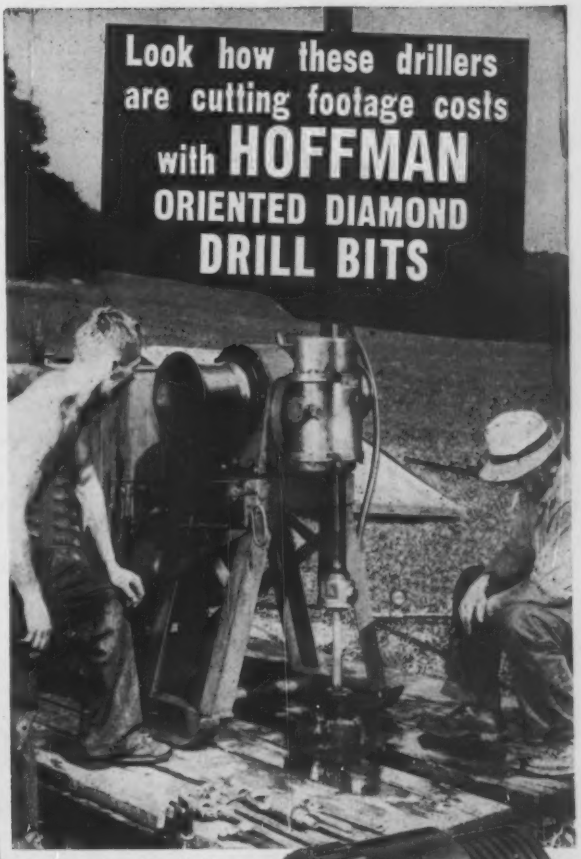

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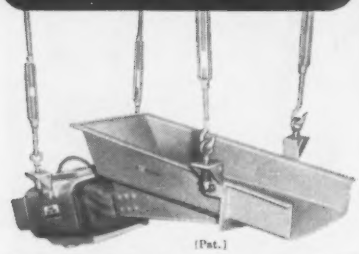

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## Patents *(Continued)*

condensing zinc as liquid from zinc vapor in which liquid lead is used as a circulating medium. Dross is withdrawn by an inclined conveyor which permits the liquid lead to drain back into the condenser. L. I. Derham, assigned to Metallurgical Development Co. No. 2,886,309.

**In the treatment of columbium-tantalum ore** to recover the metals, the ground ore is digested with ammonium fluoride after being roasted and the resulting soluble columbium and tantalum fluorides separated from the complex fluoride residue and treated separately for recovery of the two metals. A. T. McCord. No. 2,888,320.

**Pulverulent beneficiated taconite** or other low-grade iron ore is mixed with a natural brine of $CaCl_2$ and/or $MgCl_2$ and briquettd or pelletized to produce a stronger furnace-grade material than when clay or inorganic cement is used as the binder. Lower agglomerating temperatures are possible using these chloride brines. R. M. Lawless and A. F. Klopf, assigned to Dow Chemical Co. No. 2,888,341.

# New Books

**Geological Index Map of Manitoba,** showing geological and geophysical sheet is issued by the Manitoba Mines Branch and Geological Survey of Canada. Scale 20 miles to the inch. Available at the Mines Branch, Department of Mines and Natural Resources, Winnipeg, Manitoba, Canada.

**The Status of Fusion Power,** by Dr. Milton A. Rothman. The article appears in Volume 31, Number 2 of FOOT PRINTS published by Foote Mineral Co., 18 West Chelten Ave., Philadelphia 44, Pa. Introductory remarks and conclusions of the author are as follows:

"The biggest gamble in the world is being played in a number of laboratories in the United States, England and the USSR. In the United States this gamble is called Project Sherwood, and is carried on at Los Alamos, Princeton, the University of California, Oak Ridge and other places. It is a gamble because millions of dollars are being spent on a research project which possibly may be a total failure as far as the prime objective is concerned.

"However, the stakes are very, very, high, in the long run higher than that of the space program which has been more glamorously publicized. Success in this game means a source of electrical power which is virtually unlimited. It means that we will never again depend upon digging power out of the soil.

"Yet, at the present state of our knowledge we cannot be sure that what we are trying to do can be done on a practical level. Nevertheless, there are enough people with the faith and the guts to go ahead and try to overcome the formidable difficulties which have appeared in the way.

"The purpose of the project is the production of useful, controlled power by the fusion of light atomic nuclei to form heavier nuclei. This is in contrast to the process of uranium fission, in which the heaviest nuclei are split in two in order to produce useful energy. . . .

"It is clear that the development of power from controlled fusion has become in a short time a very large-scale effort, and in the future it is bound to become even more so. The ramifications into which the study of plasma physics will lead us are as yet unknown. Already new concepts have come forth such as the use of gaseous thermocouples for conversion of heat directly into electricity, and the use of plasma jets for propulsion of interplanetary vehicles.

"In this new field lithium will play a large part, by virtue of its unique and valuable nuclear properties."

**Microscopic Sedimentary Petrography,** by Albert V. Carozzi, professor on the staff of University of Illinois, and author of more than 100 publications on sedimentary petrology. Special features include an advanced discussion and detailed description of sedimentary rock types, thorough coverage of cementation process in sandstones, and complete microscopic descriptions of argillaceous, carbonate and evaporitic rocks. Published by John Wiley & Sons Inc., 440 Fourth Ave., New York 16, Pp 485. Price $11.50.

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It must disperse alkali quickly through the ore, for uniform pH.

But it must also be gentle enough not to break down the delicate uranium oxide floc into a powder that could clog filters, cause stoppages and lower the efficiency of the entire extraction process.

The mixer you see here is one of several installed after a LIGHTNIN Mixer representative asked questions, took samples, and later returned with recommendations based on actual tests run in the laboratory. These LIGHTNIN Mixers are scale-ups of the mixers that solved the problem in the lab. They provide *precisely the balance of horsepower, speed and mixing action* to meet the critical requirements of the process.

Floc stays filterable. And pH quickly arrives at its desired uniformity.

### Easy To Install

Installing these units was simple, because all LIGHTNIN Mixers are shipped fully assembled, factory-aligned, ready to install. Standard interchangeable components and easy access to all parts make maintenance easy. Aside from ordinary servicing, these mixers *have required no repairs or attention since going on the job 2½ years ago!*

### Results Guaranteed

LIGHTNIN Mixers have many uses that can pay off for you. This mine also uses them to mix the magnesia slurry that controls pH when added to the precipitation tanks, and in making up barren eluate. You can also use them to blend ores in pulp form, speed chemical reactions, condition feed for flotation cells, or solve other fluid-mixing problems. Sizes range from ¼ to 500 HP, and *results are fully predictable, unconditionally guaranteed.*

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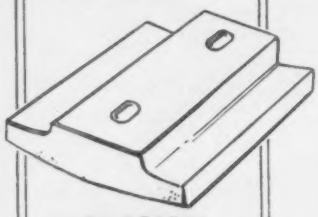

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## New Books *(Continued)*

**Tertiary Volcanic Domes Near Jackson, California,** by Robert L. Rose, assistant professor of geology, San Jose State College. Special Report 60, published by the California Division of Mines, Ferry Bldg., San Francisco, Calif. Pp 21. Price 50c.

**A Review of the Zinc Industry in the United States During 1959,** by J. L. Kimberley, executive vice president, American Zinc Institute Inc. A useful compact statistical analysis of the domestic zinc industry for students of the industry and commodity specialists. Published by American Zinc Institute Inc. 292 Madison Ave., New York 17, Pp 16.

**The U.S. Bureau of Mines** is issuing preprint chapters of the 1960 edition of its Bulletin 585, "Mineral Facts and Problems." This valuable reference volume of 88 chapters, is being republished with new statistics and other up-to-date information. Publication date of the volume will be announced later. Some of the preprint chapters so far available are as follows:

| | |
|---|---|
| Aluminum | Garnet |
| Antimony | Gem stones |
| Asbestos | Graphite |
| Barium | Hafnium |
| Bismuth | Indium |
| Boron | Iodine |
| Bromine | Lithium |
| Cadmium | Mercury |
| Cesium | Nitrogen compounds |
| Chromium | Potassium compounds |
| Columbium | Talc, soapstone and pyrophyllite |
| Diamond (industrial) | |
| Gallium | |

Prices and titles of available preprint chapters of Bulletin 585 may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D.C.

**Australian Atomic Energy Commission, Seventh Annual Report.** This complete report for Australian AEC indicates that there may be some pressure for prices below $8 per lb for $U_3O_8$ in world markets because of the uncertainties of demand for the product in non-military uses. It is estimated that by 1970 demand should overtake production. Published by the Australian Atomic Energy Commission, 45 Beach Street, Coogee, N.S.W., Australia. Pp. 48.

**Seaman's Mineral Tables,** completely revised and up-dated by Prof. Kiril Spiroff, professor of mineralogy of Michigan College of Mining and Technology. Published by the Michigan College of Mines and Technology press, Houghton, Mich. Pp 82 plus 5 plates. Price $2.

**National Objectives and the Balance of Payments Problem,** a statement of National Policy by the Research and Policy Committee of the Committee for Economic Development. Recent arguments related to the price of gold in the mining press have referred to the international deficit of the U.S. economy which resulted in the export of over $2-billion in gold during 1958. For readers who

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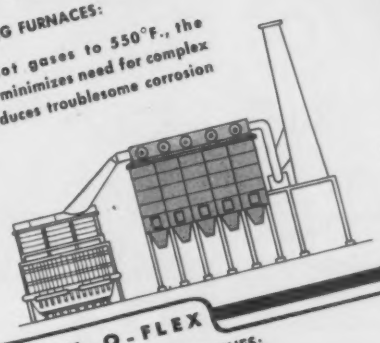

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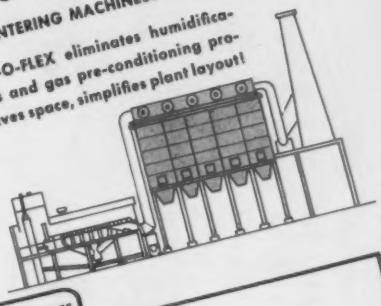

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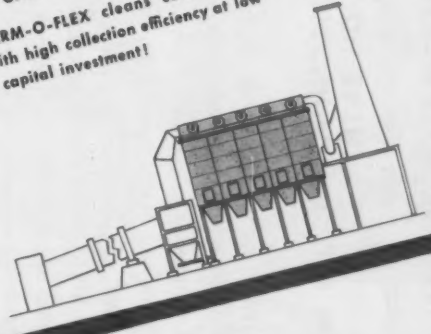

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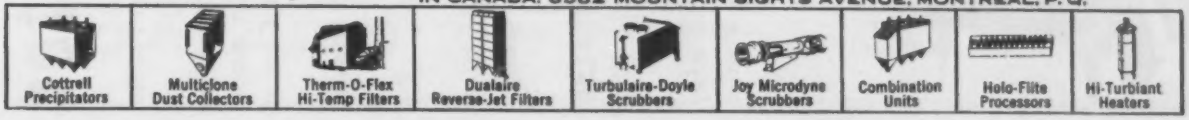
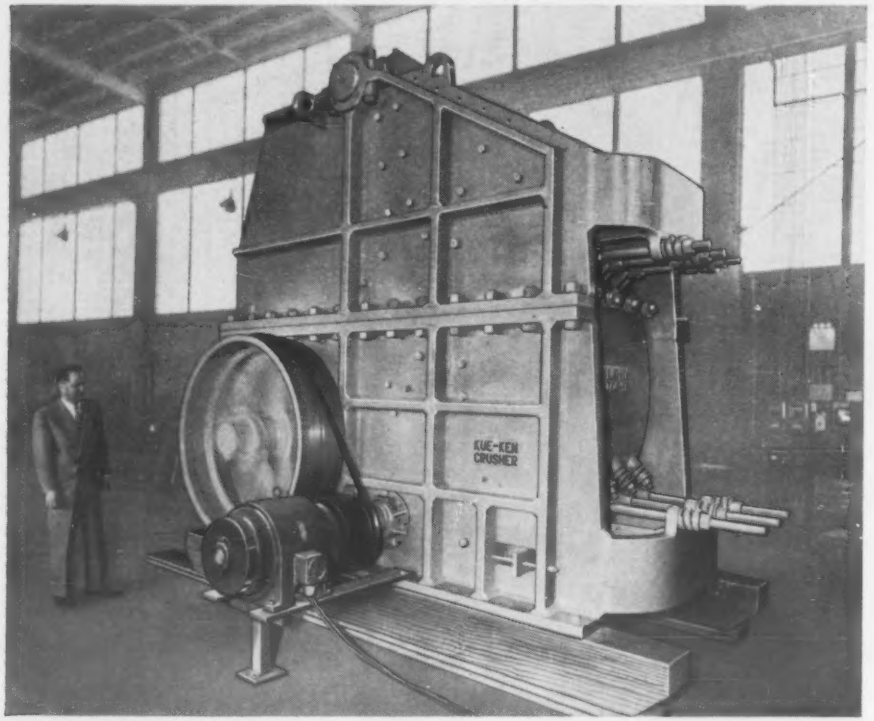


# KUE-KEN® greater leverage permits small motor




#160 — 48″x42″ KUE-KEN Jaw Crusher mounted on skids *not fastened to floor* and running at 275 RPM, the operating speed. A 30 HP normal duty squirrel cage motor starts this crusher with a single vee belt. Only 17 HP is required to run crusher at full speed. High efficiency and smooth running of KUE-KEN Crushers is clearly shown by above performance. 33 sizes of KUE-KEN Crusher available from 12″x7″ to 48″x48″.

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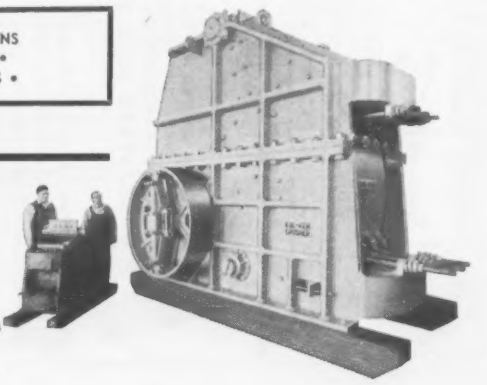

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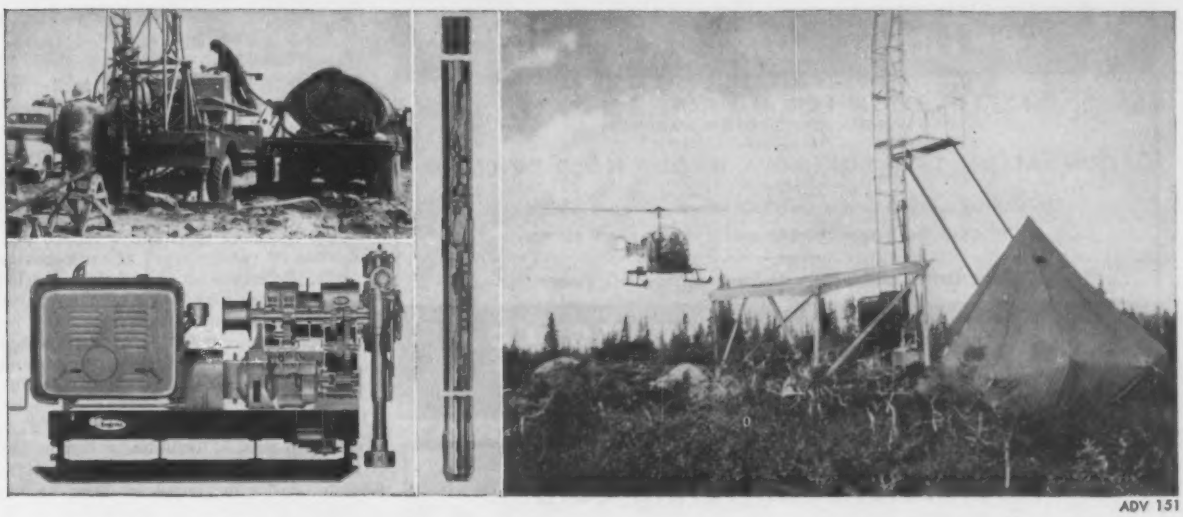

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## New Books *(Continued)*

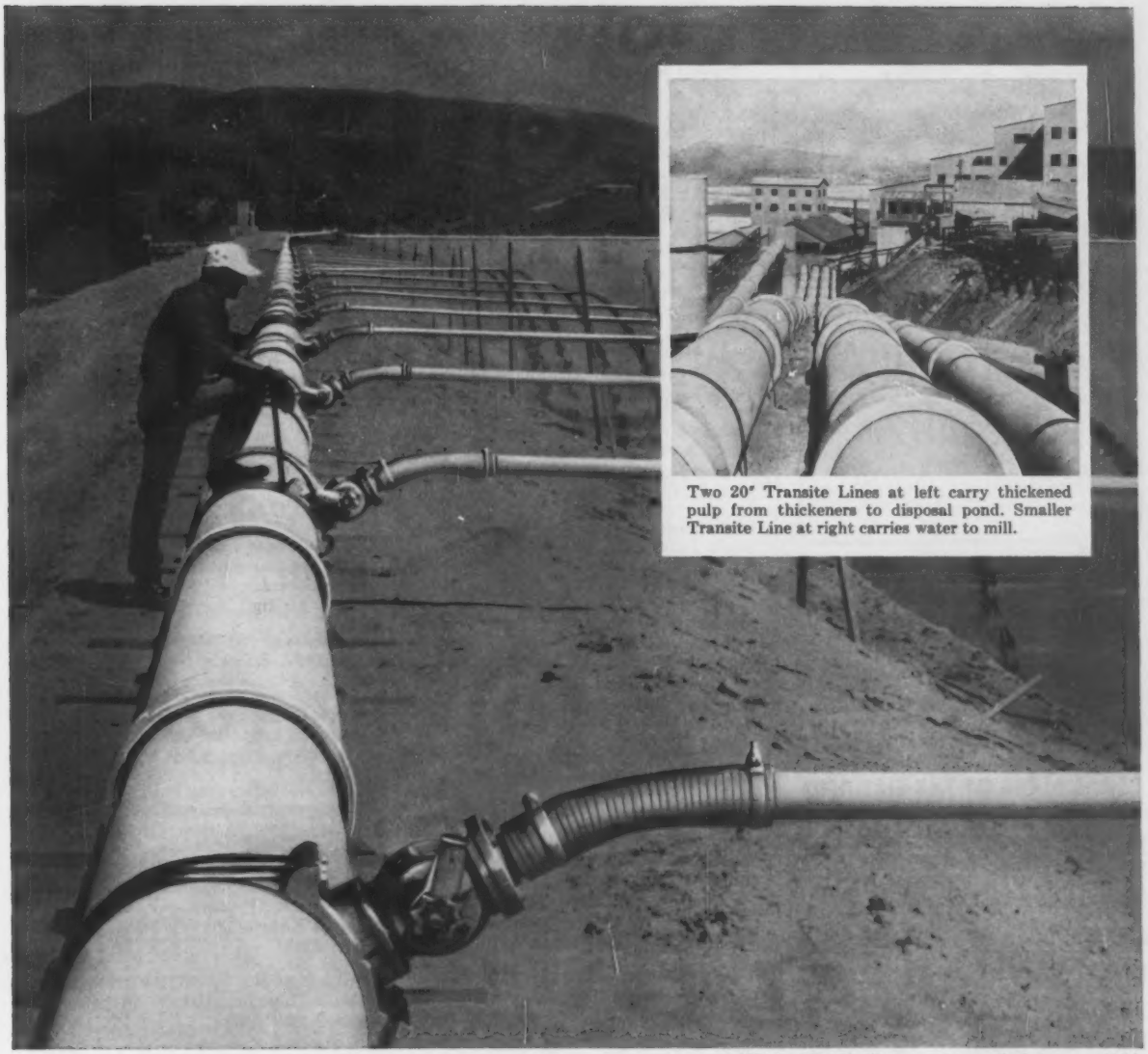
wish to be informed on gold's role in the settlement of international balances, this report presents unbiased factual background information that sheds much light on the intricacies of international finance. Although the importance of gold and the dollar is readily upheld, also the necessity of controlling the U.S. deficit in international balance of payments, the reader will find little encouragement for devaluation of the dollar or an increase of the price of gold. Trustees on the CED include representatives of steel companies, aluminum and non-ferrous metals companies, and many of the nation's largest industrial, banking and publishing firms. This report undoubtedly has received the consideration and endorsement of an impressive cross-section of U.S. industry and business. Conclusions of the report are conservative and clear. For sale by Committee for Economic Development, 711 Fifth Ave., New York 22, Pp 32. Price $1

**Basic Estimating, P=E x IH/C.** This 75-page booklet has been several years in the making. It has been prepared to help operators solve earth-moving problems. The publication outlines a flowsheet of logic to be used in determining the output of an earthmoving machine in cu yd or tons per hr. The variables mentioned in the title are identified as follows:

P = production in cu yd or tons per hr.
E = efficiency hour, in minutes
I = in-bank correction factor for the loaded machine
H = heaped capacity of the machine in cu yd or tons
C = cycle time of the machine in minute

Numerous tables, charts and formulas are presented to guide the reader in computing such factors as: The effects of altitude on machine performance, rolling resistance, coefficient of traction, travel time, fixed time factors, cycle time, fixed costs, operating costs and estimated production of various types of earth-moving units. Reference data includes: weights and measures, conveyor elevation charts, water conversion tables, tireload and inflation tables, conversion of degrees into per cent grade, and rules of thumb and formulas. This booklet is published by Sales Development Construction Equipment Div., International Harvester Co., and at present is available to responsible parties through the International Harvester dealer in your area. Price $5.

**Industrial Trucks—What do they cost to own?—to operate?—to maintain?** Lead Industries Assoc. has published this new booklet to show economies that may be expected by using battery-operated industrial trucks in preference to gasoline-powered industrial trucks. Charts and nomographs enable the reader to find: the cost of owning a truck; how to find depreciation costs; how to find operating costs; and how to find maintenance costs. Six case histories are included in the report showing how plants made substantial savings in operating costs by using battery-powered industrial trucks. This



Two 20" Transite Lines at left carry thickened pulp from thickeners to disposal pond. Smaller Transite Line at right carries water to mill.

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## New Books *(Continued)*

pamphlet will be useful in the cost-estimate files of industrial and mining engineers. Published by Lead Industries Assoc., 60 East 42nd St., New York 17, Pp 12.

### Regional Reports

**State of Alaska, Department of Natural Resources, Division of Mines and Minerals, Report for 1959.** Authors of the report observe that "gold mining is disappearing from the Alaskan scene because of the fixed price of gold and the continued inflationary spiral of operating costs." Writers of the report appeal for a price of gold at least twice the current price "to achieve any significant lasting results." Published by the Alaska Division of Mines and Minerals, Box 1391, Juneau, Alaska. Pp 80.

**Reconnaissance Geologic Map of Little Black Peak Fifteen-Minute Quadrangle, East Half, in Central New Mexico.** Geologic Map 11.

**Ontario, an Expanding Mining Empire,** a report by the Ontario Department of Mines which includes statistics, reports on active mines and a complete profile of the Ontario mining industry. Published by the Ontario Department of Mines, Toronto, Ont. Pp 139.

**Ten Aeromagnetic maps,** covering part of the 60,000 square miles in the Red Lake and Patricia districts of Northwestern Ontario, drawn on the scale of one inch to the mile are available at 25c per sheet at the Publications Branch, Ontario Department of Mines, Toronto, Ont. They may also be obtained through the Geological Survey in Ottawa.

**Gypsum-Anhydrite Depostis of Manitoba,** by B. B. Bannatyne. Gypsum production in Manitoba has increased from approximately 16,000 tons in 1940 to about 185,000 tons in 1957. This pamphlet is complete with area maps, geologic maps, lithologic sections and reports on producing mines. Published by the Manitoba Department of Mines and Natural Resources, Winnipeg, as Publication 58-2. Pp 46.

**Sixtieth Annual Report of the Mining Industry of Idaho.** Declarations of policy for the Idaho Mining Assoc. and the Northwest Mining Assoc. plus articles on phosphate, strategic minerals, gold and single-purpose land withdrawals are included in this annual report on the mining companies in Idaho. Published by the Idaho Bureau of Mines and Geology, Moscow, Idaho. Pp 116.

**Forty-Eighth Annual Report of the State Mine Inspector of Arizona,** by R. V. Hersey. Published by the State Mine Inspector, Phoenix, Ariz. Pp 28.

**Crow Wing County, Minnesota, Annual Report for 1959,** by Oliver Stark, Mine Inspector. Map and tables cover statistics and location of operating mines. Published by Mine Inspector, 412 6th St. and 5th Ave. N.E., Crosby, Minn.

### U.S.G.S. Bulletins

The following bulletins may be obtained from the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C., for the prices stipulated:

**Bibliography of North American Geology, 1957.** Bulletin 1095. Pp 531. Price $1.75.

**Selected Annotated Bibliography of Gypsum and Anhydrite in the United States and Puerto Rico.** Bulletin 1105. Pp 126. Price 50c.

**Geophysical Abstracts 179, October-December 1959.** Bulletin 1106-D. Pp 124. Price 40c.

**Geologic Reconnaissance of Semisopochnoi Island, Western Aleutian Islands, Alaska.** Bulletin 1028-O. Pp 50 plus map. Price $1.25.

**Geology of Rat Island, Aleutian Islands, Alaska.** Bulletin 1028-Q. 10 plus map. Price 35c.

**Geology of Huerfano Park Area, Huerfano and Custer Counties, Colorado.** Bulletin 1071-D. Pp 30 plus maps. Price $1.25.

**Geology and Uranium Deposits of Monument Valley, San Juan County, Utah.** Bulletin 1087-D. Pp 25 plus maps. Price $1.


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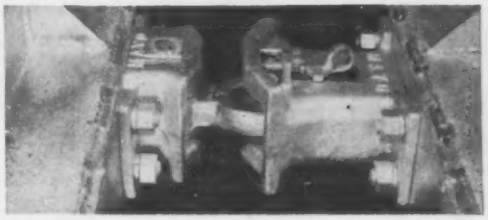

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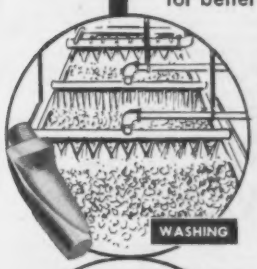

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Colorado, Denver 4: 710 West Colfax Ave.
Georgia, Atlanta: 2131 Plaster Bridge Rd., N.E.
Illinois, Chicago: 2651 Gardner Rd., Broadview, Ill.
Minnesota, Minneapolis 2: 1002 Baker Bldg.
Missouri, Kansas City 5: 20 West 9th Street Bldg.
New York, New York 7: 30 Church St.
Texas, Dallas 7: 2621 Irving Blvd.

**American Brattice Cloth Corp., Argonne Road, Warsaw, Ind.**
Ohio, Cleveland: 1313 West 11th St.

**American Cyanamid Co., 30 Rockefeller Plaza, New York 20, N.Y.**
Colorado, Denver: 1445 Kearney St.
Massachusetts, Maynard: Box 5
Missouri, Kansas City: 3125 Gilham Plaza
Missouri, St. Louis: 5025 Pattison Ave.
New Mexico, Albuquerque: 1719 Van Court, S.W.
Oklahoma, Tulsa: Route 3, Box 192
Pennsylvania, Latrobe: P. O. Box 270
Pennsylvania, Pottsville: 209 N. 19th St.
Texas, Dallas: 3709 Atwell St.
Utah, Salt Lake City: 515 Walker Bank Bldg.
West Virginia, Bluefield: 135 Bradman Bldg.

**American Machine & Metals, Inc., East Moline, Ill.**
California, Pasadena: 385 East Green St.
Colorado, Denver: 847 East 17th Ave.
Georgia, Atlanta 9: 1371 Peachtree St., N.E.
Illinois, Chicago: 600 South Michigan Ave.
Minnesota, Minneapolis: 620 Plymouth Bldg.
New York, New York 7: 233 Broadway
Ohio, Cleveland: 3639 Lee Rd.
Pennsylvania, Pittsburgh: 2210 Koppers Bldg.
Texas, Houston: 2401 Dunstan Rd.
West Virginia, Charleston 3: 1108 Nelson Bldg.

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**American Manganese Steel Div., American Brake Shoe Co., 389 East 14th St., Chicago Heights, Ill.**
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Colorado, Denver: 4th and Wazee Streets
Delaware, New Castle
Illinois, Chicago: 155 North Wacker Drive
Minnesota, St. Paul: 519 North Cleveland Ave.
Missouri, St. Louis: 6600 Ridge Ave.
New Jersey, Glen Ridge: 45 Forest Ave.
New York, New York: 530 Fifth Ave.
Pennsylvania, Pittsburgh: 717 Grant Building
Canada, Quebec
Canada, Joliette
Canada, Montreal: 1405 Peel Street

**American Metal Climax, Inc., 1270 Ave. of the Americas, New York 20, N. Y.**

**American Mine Door Co., 2039 Dueber Ave., S.W., Canton 6, Ohio.**
Alabama, Birmingham 5: 429 South 24th St.
Arizona, Phoenix: 35 E. Pierson St.
Colorado, Denver 2: 1921 North 13th
Indiana, Vincennes: 1648 North 13th St.
Kentucky, Madisonville: 110 N. Franklin St.
Michigan, Ishpeming: 115 South First St.
Minnesota, Hibbing: 522 West 27th St.
New Mexico, Albuquerque: 1404 Martha NE
Utah, Salt Lake City 4: 1020 South Sixth West
Washington, Spokane; 311 N. Adams Road

**American Potash & Chemical Corp., 3000 West 6th St., Los Angeles 45, Calif.**
California, San Francisco 4: 235 Montgomery Street
Georgia, Atlanta 3: 214 Walton Building
Illinois, Chicago 45: 3557 West Peterson
Louisiana, Shreveport: 1600 Fairfield Avenue
New York, New York 16: 99 Park Avenue
Ohio, Columbus 21: 2025 Riverside Drive
Oregon, Portland 1: 1320 S.W. Broadway

**American Smelting & Refining Co., 120 Broadway, New York 5, N. Y.**

**American Steel & Wire Div., U.S. Steel Corp., Rockefeller Bldg., Cleveland, Ohio**

**Anaconda Wire and Cable Co., 25 Broadway, New York 4, N. Y.**
California, Los Angeles 17: 807 Douglas Oil Bldg.
California, San Francisco 4: Room 2375, 120 Montgomery St.
Colorado, Denver 2: Room 706, Railway Exchange Bldg., 909 Seventeenth St.
Illinois, Chicago 6: 20 North Wacker Dr.
Louisiana, New Orleans 19: 240 Caribe Bldg.
Massachusetts, Cambridge 42: Kendall Square Bldg., 238 Main St.
Michigan, Detroit 2: 621 New Center Bldg.
Minnesota, Minneapolis 2: Room 1715 Foshay Tower, 821 Marquette Ave.
Missouri, St. Louis 8: 1705 Continental Bldg., 3615 Olive St.
New York, New York 6: Room 2611-12, 21 West St.
North Carolina, Charlotte 2: 213 Wilder Bldg.
Pennsylvania, Philadelphia 3: Room 10, 1616 Walnut St. Bldg.
Pennsylvania, Pittsburgh 22: 1526 Bldg. No. 3, Gateway enter
Texas, Dallas 1: 1201 Fidelity Union Life Bldg., 1511 Bryan St.
Washington, Seattle 1: 954 Stuart Bldg., Metropolitan Center
West Virginia, Charleston 1: 501, 503, 505 Peoples' Bldg.
Wisconsin, Milwaukee 3: Room 368 Bockl Bldg., 2040 West Wisconsin

**Armour Chemical Div., 110 North Wacker, Chicago, Ill.**
Florida, St. Petersburg: 3800 Kingfish Dr. S.E.
North Carolina, Charlotte 8: 2000 Thrift Rd.
Oregon, Portland: 49 S.E. Clay St.
Texas, Dallas: 5738 N. Central Expressway
Texas, Midland: 139 Allen Bldg.

**Asea Electric Inc., 500 Fifth Ave., New York 36, New York**

**Atlas Car & Mfg. Co., 1140 Ivanhoe Rd., Cleveland 10, Ohio**

**Atlas Copco, 545 Fifth Ave., New York 17, N. Y.**
Arizona, Phoenix: 1326 N. 22nd Ave.
California, San Carlos: 930 Brittan Ave.
Colorado, Denver: 2360 S. Delaware St.
Minnesota, Duluth: 212-216 S. 1st Ave., E.
Missouri, St. Louis: 3147 Locust Blvd.
New Jersey, Paramus: 610 Industrial Ave.
Tennessee, Knoxville: 305 Randolph St.
Utah, Salt Lake City: 1065 S. 2nd W. St.
Washington, Spokane: 1509 W. 2nd St.

**Atlas Powder Co., Wilmington 99, Del.**
California, San Mateo: 2036 Pioneer Court
Delaware, Wilmington 99
Illinois, Chicago 3: 1606 Field Bldg., 135 S. LaSalle St.
Missouri, Joplin: 612 First National Bldg.
Pennsylvania, Pittsburgh 22: 1544 Oliver Bldg.
Tennessee, Knoxville 3: Hamilton National Bank Bldg.
Washington, Seattle 1: 1320 Joseph Vance Bldg.

**Autocar Div., The White Motor Co., Exton, Pa.**
Alabama, Birmingham 3: 1701 3rd Ave., South
California, Los Angeles 15: 400 E. Washington Blvd.
California, San Francisco 7: 590 Brannan St.
Colorado, Denver 5: 5165 Vasquez Boulevard
Florida, Jacksonville: 5175 West Beaver St.
Georgia, Atlanta 7: 70 Boulevard, N.E.
Illinois, Chicago 16: 2401 Archer Ave.
Illinois, Chicago Northside: 6421 W. Fullerton Ave.
Indiana, Indianapolis 2: 1400 N. Senate Ave.
Kentucky, Louisville 2: 3700 Crittenden Drive
Louisiana, New Orleans 13: S. Claiborne at Earhart Blvd.
Maryland, Baltimore 18: 708-728 E. 25th St.
Massachusetts, Boston 15: 930 Commonwealth Ave.
Michigan, Detroit 16: 2950 Twelfth St.
Minnesota, Minneapolis 14: 2812 University Ave., S. E.
Missouri, Kansas City 6: 522 Locust St. Trafficway
Missouri, St. Louis 6: 1415 N. 13th St.
Nebraska, Omaha 2: 20th & Leavenworth St.
New Jersey, Newark 5: 190 Murray St.
New York, Albany 4: 460 N. Pearl St.
New York, Buffalo 4: 85 Michigan Ave.
New York, New York 17: 415 Madison Ave.
New York, New York 36: 547 W. 47th St.
North Carolina, Charlotte 8: 1514 W. Morehead St.
North Carolina, Winston-Salem: P. O. Box 7505, Reynolds Station
Ohio, Akron 6: 1250 Triplett Blvd.
Ohio, Cincinnati: 4131 Grove Avenue at Winton Road
Ohio, Cleveland 1: 1421 E. 49th St.
Oklahoma, Oklahoma City: 1001 S. W. 3rd St.
Oregon, Portland 10: 2705 N. W. Nicolai St.
Pennsylvania, Philadelphia 32: 34th & Indiana Ave.
Pennsylvania, Pittsburgh 33: 1136 Western Ave.
Rhode Island, Providence: 40 Branch Ave.
Texas, Dallas 1: 2000 S. Ervay St.
Texas, Fort Worth 1: 825 W. Vickery Blvd.
Texas, Houston 1: 4720 Gulf Freeway
Wisconsin, Milwaukee 3: 2440 W. Clybourn St.
Canada, Toronto, Ontario: The White Motor Company of Canada, Ltd., 1041 The Queensway

## B

**Babcock & Wilcox Co., 161 East 42nd St., New York 17, N. Y.**
Georgia, Atlanta 3: Candler Bldg.
Illinois, Chicago 3: 105 S. LaSalle St.
Massachusetts, Boston 10: 140 Federal St.
Michigan, Detroit 26: Ford Bldg.
Minnesota, Minneapolis 2: Northwest Bank Bldg.
Missouri, Kansas City 6: 1012 Baltimore Ave.
Missouri, St. Louis 3: Shell Bldg.
New York, Syracuse 2: State Tower Bldg.
North Carolina, Charlotte 2: Wachovia Bank Bldg.
Ohio, Cincinnati 2: Carew Tower
Ohio, Cleveland 13: Illuminating Bldg.
Pennsylvania, Philadelphia 2: 3 Penn Center
Pennsylvania, Pittsburgh 19: Koppers Bldg.

**Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio**
California, San Francisco: 55 New Montgomery St.
Colorado, Denver: 1506 Kearney St.
Georgia, Atlanta: 1145 Peachtree St. N.E.
Michigan, Detroit: 18928 W. McNichols Rd.
Missouri, St. Louis: 8924 Manchester Ave.
Ohio, Cincinnati: 2330 Victory Parkway
Pennsylvania, Philadelphia: 29 Bala Ave., Bala-Cynwyd
Pennsylvania, Pittsburgh: 875 Greentree Rd.
Utah, Salt Lake City: 2664 Capricorn Way
Washington, Seattle: 200 Broadway
West Virginia, Charleston: 836 Carroll Rd.
Wisconsin, Milwaukee: 9137 W. Lisbon Ave.

**Barber-Greene Company, 400 North Highland Ave., Aurora, Ill.**
Alabama, Birmingham: 512 North 18th St.
California, South San Francisco: 320 Victory Ave.
California, Whittier: 1402 West Hadley St.
Florida, Orlando: 711 Magnolia Ave.
Illinois, Chicago 6: 9 South Clinton St
Massachusetts, Needham Heights 94: 57 Crawford St., P. O. Box 98
Minnesota, Minneapolis: 5605 Lyndale Ave., South
New York, New York 17: 441 Lexington Ave.
New York, Syracuse 2: 217 Montgomery St.
Texas, Dallas 6: 4515 Prentice St.

**Bemis Bro. Bag Company, 408 E. Pine St., St. Louis 2, Mo.**
Alabama, Mobile 6: P. O. Box 1110
Arizona, Phoenix: P.O. Box 6504
California, San Francisco: P.O. Box 2536, Station "B"
California, Wilmington: P. O. Box 1087
Colorado, Denver 2: P.O. Box 1638
Idaho, Boise: P.O. Box 1638
Illinois, Chicago: 6: 110 N. Wacker Drive
Indiana, Indianapolis: 1940 Barth Ave.
Kansas Salina: P.O. Box 417
Kansas, Wichita 1: P. O. Box 207
Louisiana, New Orleans 12: 330 Notre Dame St.
Maryland, Baltimore 10: 312-A Wyndhurst Ave.
Massachusetts, Boston 9: 40 Central St.
Michigan, Detroit 27: 12736 Fenkell Ave.
Minnesota, Minneapolis 15: 600 Fourth St., South
Missouri, Kansas City 1: 925 Wyoming St.
Missouri, St. Louis 2: 601 South 4th St.
Nebraska, Omaha 8: 618 South 11th St.
New York, Brooklyn 1: 26 Court St.
New York, Buffalo 5: P. O. Box 118
New York, New York 17: 60 East 42nd St. Suite 1320
North Carolina, Charlotte 5: P.O. Box 9145, Plaza Station
Ohio, Cleveland 13: 2012 West 25th St.
Oklahoma, Oklahoma City: 502 Commerce Exchange Bldg.
Tennessee, Memphis: P. O. Box 2566, De Soto Station
Texas, Houston 1: P. O. Box 1228
Utah, Salt Lake City 1: 1101 Walker Bank Bldg.
Virginia, Norfolk 8: 1037 West 26th St.
Washington, Seattle 4: 65 Atlantic St.
Washington, Vancouver: 1401 West 26th St.

**Bethlehem Steel Co., Bethlehem, Pa.**
California, Los Angeles 54: Box 2057 Terminal Annex
California, San Francisco 19: 20th & Illinois Sts.
Canada, Montreal: Dominion Square Bldg.
Canada, Toronto: 170 University Ave.
Georgia, Atlanta 1: 1312 Fulton Nat'l Bank Bldg., 55 Marietta St.
Illinois, Chicago 1: 2700 Prudential Bldg., Prudential Plaza
Illinois, Herrin: 500 W. Monroe St.
Kentucky, Louisville 6: 3321 Trinity Rd.
Maryland, Baltimore 3: 300 St. Paul Place
Massachusetts, Boston 10: 75 Federal St.
Michigan, Detroit 2: General Motors Bldg., 3044 West Grand Blvd.
Minnesota, St. Paul 1: First Nat'l Bank Bldg., 335 Robert St.
Missouri, St. Louis 5: 212 So. Central Ave.
New York, Albany 7: 90 State St.
New York, Buffalo 2: 1515 Liberty Bank Bldg., 424 Main St.
New York, New York 2: 375 Park Ave.
Ohio, Cincinnati 2: 1401 Fifth Third Bank Bldg., 4th & Walnut Sts.
Ohio, Cleveland 13: 2700 Terminal Tower, 50 Public Square
Oregon, Portland 5: 1010 S. W. Fourteenth Ave.
Pennsylvania, Johnstown: Bethlehem Bldg., 119 Walnut St.
Pennsylvania, Philadelphia 3: 1058 Suburban Sta. Bldg., 1617 Penna. Blvd.
Pennsylvania, Pittsburgh 22: 1200 Oliver Bldg., Mellon Square
Texas, Houston 1: 7100 Clinton Dr.
Washington, Seattle 4: 3651 E. Marginal Way
West Virginia, Bluefield: 2415 Bland Rd.
West Virginia, Charleston: One Morris Apts., 1 Morris St.

**Birdsboro Corporation, Birdsboro, Pa.**

**Broderick & Bascom Rope Co., 4203 Union Blvd., St. Louis 15, Mo.**

**Brown Boveri Corp., 19 Rector St., New York 6, N. Y.**

**Brunner & Lay, Inc., 9300 King St., Franklin Park, Ill.**
Alabama, Birmingham: 5 18th St., S. W.
California, Los Angeles: 2425 E. 37th St.
California, Sacramento: 7500 14th Ave.
Massachusetts, Dorchester: 203 Victory Rd.
New Mexico, Albuquerque: 2224 Broadway, S. E.
New York, Long Island City: 43-11 Eleventh St.
North Carolina, Asheville: Sweeten Creek Rd.
Pennsylvania, Philadelphia: 2514 E. Cumberland St.
Texas, Dallas: 150 Leslie St.
Washington, Seattle: 2600 1st Ave. & Vine
Washington, Yardley: 5311 E. Railroad Ave.
Canada, Lachine, P. Q.: 2280—43rd Ave.

**Buell Engineering Co., 123 William St., New York 38, N. Y.**

## C

**Card Iron Works, C. S., 2501 West 16th Ave., Denver 4, Colo.**

**Caterpillar Tractor Co., Peoria, Ill.**

**Cheatham Electric Switching Device Co., 4780 Crittenden Drive, Louisville 9, Ky.**
Utah, Salt Lake City: 375 South West Temple

**Chicago Pneumatic Tool Co., 6 East 44th St., New York 17, N. Y.**
Alabama, Birmingham: 810 Fifth Ave. North
California, Los Angeles 22: 6935 Bandini Blvd.
California, South San Francisco: 145 Mitchell Ave.
Colorado, Denver 4: 465 Acoma St.
Illinois, Chicago 19: 936 East 87th St.
Missouri, St. Louis 3: 1931 Washington Ave
Missouri, St. Louis 17: 8029 Litzsinger Rd.
New York, New York 17: 6 E. 44th St.
Ohio, Cincinnati: 4511 Reading Rd.
Ohio, Cleveland: 1643 Superior Ave.
Pennsylvania, Pittsburgh 13: 369 Coltart St.
Pennsylvania, Wynnewood: 312 E. Lancaster Ave.
Utah, Salt Lake City 1: 156 West Fourth South
Washington, Seattle 4: 2901 First Ave. South

**Christensen Diamond Products Co., 1937 South 2nd West, Salt Lake City Utah**

**Clark Equipment Co., Construction Equipment Div., 2465 Pipestone Rd., Benton Harbor 40, Mich.**

**Coates Steel Products Co., Greenville, Ill.**

**Connellsville Manufacturing and Mine Supply Co., S. Fourth St., P. O. Box 677, Connellsville, Pa.**
Alabama, Birmingham 3: 2313 Sixth Ave., South
Michigan, Iron Mountain—Champion, Inc.
Texas, El Paso: 1901 Bassett Ave., P. O. Box 226
West Virginia, Bluefield: 709 Albemarle St.

**Corpus Engineering Corp., Worcester 10, Mass.**

**Crosby-Laughlin Div. of American Hoist & Derrick Co., 63 South Robert St., St. Paul 7, Minn.**
California, Berkeley 7: 674 Santa Rosa
California, Burlingame: 1300 Montero
Georgia, Atlanta 19: 2718 Osborne Road N. E.
Illinois, LaGrange: Unit No. 7, 905 West Hillgrove Ave.
Iowa, Des Moines: 2024—39th St.
Michigan, Detroit 19: 9130 West Outer Dr.
Minnesota, Minneapolis: 4152 Park Ave.
New Jersey, South Kearny: Foot of Jacobus Ave.
Pennsylvania, Blue Bell: Stony Brook Dr.
Pennsylvania, Pittsburgh 22: 1 Cedar Blvd., Room 112
Texas, Dallas: 6339 Woodland Dr.
Texas, Houston 25: 3650 Glen Haven St.
Washington, Seattle: 4975—3rd Ave. South

**Crucible Steel Co. of America, Gateway No. 4, Pittsburgh 22, Pa.**
California, Los Angeles 22: 6033 E. Bandini Blvd.
California, San Francisco 10: 2050 Bryant St.
Colorado, Denver 16: 6301 Colorado Blvd.
Georgia, Atlanta: 3400 Malone Dr., Chamblee
Illinois, Chicago 39: 4501-4531 W. Cortland St.
Massachusetts, Boston 54: Waltham Industrial Center, 45 1st Ave., Waltham, Mass.
Michigan, Detroit 34: 4920 E. Nevada Ave.
Missouri, St. Louis 14: 8610 Page Blvd.
Minnesota, Minneapolis 14: 2911 Como Ave., S. E.
New Jersey, West Caldwell: P. O. Box 556
Oregon, Portland 10: 2330 N. W. Raleigh St.
Pennsylvania, Philadelphia: 408 S. Oak Lane, Primos
Pennsylvania, Pittsburgh 5: P. O. Box 4514
Utah, Salt Lake City: 753 W. 8th St., S., P. O. Box 1694
Washington, Seattle 4: 2755 First Ave South
Wisconsin, Milwaukee 9: P. O. Box 6007, Station "F" 4200 West Douglas Rd.
Canada, Sorel, Quebec: Crucible Steel of Canada Ltd.

**Cummins Engine Co., Inc., Columbus, Indiana**
California, Los Angeles: Suite 1032, IBM Bldg.
California, San Francisco 4: 1557 Russ Bldg.
Colorado, Denver 2: 1726 Champa St.
Georgia, Atlanta 5: 359-61 E. Paces Ferry Rd., N. E.
Illinois, Chicago 3: 8 So. Michigan Ave.
Minnesota, Minneapolis: Sixth St. & Marquette Ave.
Missouri, St. Louis 3: 1221 Locust St.
New York, New York: 375 Park Ave.
North Carolina, Greensboro: 601 N. Elm St.
Ohio, Cleveland 14: 501 Fidelity Bldg.
Pennsylvania, Harrisburg: 3rd & State Streets
Texas, Fort Worth 2: 1804 Fair Bldg.
Washington, Seattle 1: 935 Securities Bldg.
Canada, Toronto 9: 2489 Bloor St., W.

**Curtiss-Wright Corp., South Bend Div., South Bend, Ind.**
Nevada, Reno: 111 North Virginia St.

## D

**Deere & Company, 3300 River Dr., Moline, Ill.**
California, San Francisco 19: Box 3573 Rincon Annex
Georgia, Chamblee: Box 4899
Illinois, Moline: 400—19th St.
Indiana, Indianapolis 7: 1025 W. Washington St.
Maryland, Baltimore 18: 2524 Kirk Ave.
Michigan, Lansing 3: Box 720
Minnesota, Minneapolis 1: 800 Washington Ave. N.
Missouri, Kansas City 30: Southeast Station
Missouri, St. Louis 6: 2212-20 N. Broadway
Nebraska, Omaha 2: 912 Howard St.
New York, Syracuse 1: Box 565
Ohio Columbus 8: 1573 Olentangy River Rd.
Oregon, Portland 14: 215 S. E. Morrison St.
Texas, Dallas 20: Box 13125
Canada, Alberta, Calgary: 201 Tenth Ave. East
Canada, Manitoba, Winnipeg: Box 926
Canada, Ontario, Hamilton: Box 355—Main P. O.
Canada, Saskatchewan, Regina: 7th & Broad Sts.

**Deister Concentrator Co., Inc., 903 Glasgow Ave., Fort Wayne, Ind.**
Alabama, Birmingham: 2612 N. 24th St.
California, Los Angeles: 2020 Sacramento St.
New York, New York 4: 60 Beaver St.
Pennsylvania, Nesquehoning: 35 E. Center St.

**Deister Machine Co., 1933 East Wayne St., Fort Wayne 4, Indiana**

**Diamond & Co., Inc., T. L., 1 Wall St., New York 5, N. Y.**

**Diamond Drill Contracting Co., Station B—Box 4065, North 1015 Yardley St., Spokane 31, Wash.**

**Diamond Tool Research Co., Inc., 380 Second Ave., New York 10, N. Y.**
California, Los Angeles: 220 West 5th St., Western Div.

**Diesel Energy Corp., 82 Beaver St., New York, N. Y.**

**Differential Steel Car Co., Findlay, Ohio**

**Dings Magnetic Separator Co., 4740 West Electric Ave., Milwaukee 46, Wisc.**

**Dorr-Oliver Incorporated, 77 Havemeyer Lane, Stamford, Conn.**
California, Los Angeles 17: 811 West 7th St.
California, Oakland 1: 2900 Glascock St.
Colorado, Denver: P. O. Box 149 (Englewood)
Georgia, Atlanta: 900 Peachtree St., N. E.
Illinois, Chicago 54: 813 Merchandise Mart
Maryland, Baltimore 18: 2125-27 Maryland Ave.
Minnesota, Virginia: 204 Chestnut Ave.
Ohio, Cleveland 7: 14700 Detroit Ave.
Pennsylvania, Pittsburgh 27: 4209 Clairton Blvd.
Texas, Dallas 25: 6115 Berkshire Lane
Washington, Seattle 99: 420 First Avenue West

**Dravo Corporation, Neville Island, Pittsburgh 25, Pa.**

**Ducon Company, Inc., 147 E. 2nd St., Mineola, L. I., N. Y.**
Canada, Burlington, Ontario: 1131 Pettit St.

**Du Pont De Nemours & Co., E. I., Elastomer Chemicals Dept., Wilmington 98, Del.**

## E

**Eastern Sales Co., P. O. Box 1062, Pittsburgh 30, Pa.**

**Eimco Corp., 634 South 4th St. West, Salt Lake City 10, Utah**
Alabama, Birmingham 9: Montgomery Highway, Vestavia Hills P. O. Box 6047
California, So. San Francisco, 115 Harbor Way
California, San Mateo: 420 Peninsular Ave.
Illinois, Palatine: 301 S. Hicks Rd.
Minnesota, Duluth 12: 1823 E. Superior St.
New York, New York 5: 51-52 South Street
Ohio, Cleveland: 334 Union Bldg., 1836 Euclid Ave.
Pennsylvania, Pittsburgh 5: P. O. Box 666-A, R. D. 5
Texas, El Paso: 1225 Mills Bldg.
Texas, Houston 6: 3215 W. Alabama St.

**Electric Steel Foundry Co., 2141 N.W. 25th Avenue, Portland 10, Oregon**
California, Emeryville 8: 1280 65th St.
California, Los Angeles: 1615 East Corvette
Colorado, Denver: 3940 Grape St.
Illinois, Danville: 1017 Griggs St.
New York, New York: 420 Lexington Ave.
Oregon, Eugene: 1464 W. 6th St.
T. H., Honolulu: 630 South Queen St.
Washington, Seattle: 1131 W. Hanford St.
Washington, Spokane: 1327 N. Washington St.
B. C., Vancouver: 8425 Ontario St.
Ontario, Toronto: 32 Taber Rd.
Quebec, Montreal: 2203 Beaconsfield Ave.

**Elektrokemisk, A. S., 101 Park Ave., New York, N. Y.**

**Ellicott Machine Corp., 4811 Bush St., Baltimore 30, Md.**
California, San Francisco 5: Room 510 Underwood Building, 525 Market St.

**Ensign-Bickford Co., 660 Hopmeadow St., P. O. Box 308, Simsbury, Conn.**

**Equipment Engineers, Inc., 737 Loma Verde Ave., Palo Alto, Calif.**

**Erie Manufacturing Co., P. O. Box 178, Glenside, Pa.**
Alabama, Birmingham 13: P. O. Box 9178
Colorado, Denver 18: 847 East 17th Ave.
Minnesota, Minneapolis 8: 2910 Lyndale Ave. South
Missouri, St. Louis 17: 1110 Brentwood Blvd.
Ohio, Cincinnati 15: 730 Brooks Ave.
Pennsylvania, Pittsburgh 20: One Parkway Center, 875 Greentree Rd.
Utah, Salt Lake City 10: 545-585 West Eighth South St. P.O. Box 209
Washington, Seattle 9: 418 Eighth Ave., North
Canada, Quebec, Montreal 9: 1244 Bois Franc Blvd., St. Laurent
Canada, Ontaro, Toronto 19: 164 Bentworth Ave., P. O. Box 8, Station "T"

**Euclid, Div. of General Motors Corp., 1361 Chardon Rd., Cleveland 17, Ohio**
California, Oakland 12: Room 660, El Dorado Bldg., 360 22nd St.
Georgia, Atlanta 5: Suite 3-H Luckie Bldg., 361 E. Paces Ferry Raod, N. E.
Missouri, Kansas City: 702 V F W Bldg., 406 West 34th St.
New York, N. Y. 17: Room 901, 295 Madison Ave.

# District Sales Offices of E&MJ Guidebook Advertisers

**Exide Industrial Div., Electric Storage Battery Co., Rising Sun & Adams Ave., Philadelphia 20, Pa.**

## F

**Fairbanks, Morse & Co., 600 S. Michigan Ave., Chicago 5, Ill.**
California, Los Angeles 58: 4535 South Soto St.
California, San Francisco 7: 630 Third St.
Colorado, Denver 16: 4995 Colorado Blvd.
Florida, Jacksonville 5: 533 Stevens St., P. O. Box 6574
Georgia, Atlanta 10: 760 Lee St., S. W.
Illinois, Chicago 5: 1550 S. State St.
Indiana, Indianapolis 7: 1499 N. Harding St.
Kentucky, Louisville 8: 2008 South Brook St.
Louisiana, New Orleans: 1000 St. Charles Ave.
Massachusetts, Boston 10: 178 Atlantic Ave.
Michigan, Detroit 13: 8655 East Eight Mile Rd.
Minnesota, Minneapolis 15: 1121 Flour Exchange Bldg.
Minnesota, St. Paul 1: 220 E. Fifth St.
Missouri, Kansas City 2: 2500 W. Pennway
Missouri, St. Louis 2: 217 S. Eighth St.
Nebraska, Omaha 2: 902 Harney St.
New Jersey, Fair Lawn: 19-01 Route 208
New York, Buffalo 3: 33-37 Franklin St.
North Carolina, Charlotte 2: 533 Stevens St., P. O. Box 6574
Ohio, Cincinnati 37: 4815 Para Dr.
Ohio, Cleveland 11: 3000 W. 117th St.
Oklahoma, Tulsa 3: 1225 Hunt Bldg.
Oregon, Portland 14: 105 S.E. Taylor St.
Pennsylvania, Philadelphia 8: 401 N. Broad St.
Pennsylvania, Pittsburgh 24: 4301 Main St.
Tennessee, Knoxville 16: 2202 West Cumberland Ave.
Tennessee, Memphis 5: 676 Jefferson Ave.
Texas, Dallas 2: 1713 N. Market St.
Utah, Salt Lake City 1: 153 W. Second South St.
Washington, Seattle 4: 668 Lane St.

**Falk Corp., Box 492, Milwaukee 1, Wis.**
Alabama, Birmingham 3: Rm. 649, Brown-Marx Bldg.
California, Los Angeles 22: P. O. Box 22049
California, San Francisco 7: 427 Bryant St.
Colorado, Denver 3: 655 Broadway Bldg.
Illinois, Chicago 3: 105 W. Adams St.
Illinois, Peoria: 800 S. W. Adams St.
Minnesota, Minneapolis 4: 807 Thirteenth Ave. South
Missouri, St. Louis 5: 8029 Forsyth Blvd.
New York, New York 17: 200 East 42nd St., Room 2800
Ohio, Cleveland 15: 2036 E. 22nd St., Rm. 215
Pennsylvania, Philadelphia: P. O. Box 313—Wynnewood
Pennsylvania, Pittsburgh 34: 300 Mt. Lebanon Blvd., Suite 200B
Utah, Salt Lake City 15: 2520 S. State St.—Rm. 207
West Virginia, Charleston 2: P. O. Box 10066
Wisconsin, Milwaukee 1: Box 492

**Fate-Root-Heath Co., Plymouth Locomotive Works Div., Plymouth, Ohio**

**Firestone Tire & Rubber Co., 12 S. Main St., Akron 12, Ohio**

**Flexaust Co., 100 Park Ave., New York 17, N. Y.**

**Flexible Steel Lacing Co., 4807 Lexington St., Chicago 44, Ill.**
California, San Mateo: 10 Jody Court
Connecticut, Fairfield: 139 Short Hill Lane
Georgia, Atlanta 19: 1224 Spring Mill Court
Illinois, Wheaton: RFD 2, Box 25, Orchard Rd.
Indiana, Indianapolis 20: 1006 Chevy Chase Lane
Minnesota, Wayzata: Route 1, Box 34
Missouri, Kansas City 13: 630 Huntington Rd.
North Carolina, Raleigh: 2518 Clark Ave.
Ohio, Vermilion: Portage Dr., Vermilion Lagoons
Pennsylvania, Springfield, Dela. Co., 490 Kerr Lane
Texas, Dallas 8: 1330 Hollywood Ave.
Washington, Seattle 77: 2403 W. 197th St.
Canada, Ontario, Toronto 12: 54 Mason Blvd.

**Flygt Corp., Hoosick Falls, N. Y.**

**Foxboro Co., Foxboro, Mass.**
Alabama, Birmingham 13: No 9 Office Park
Colorado, Denver 6: 2829 E. 2nd Ave.
Pennsylvania, Pittsburgh 5: 2270 Noblestown Rd.
Utah, Salt Lake City 15: 2520 South State St.
West Virginia, Charleston 1: 309 Nelson Bldg.

## G

**Gardner-Denver Corp., Quincy, Ill.**
California, Los Angeles 22: 7654 E. Slauson Ave.
California, San Francisco 7: 811 Folsom St.
Colorado, Denver 1: 1727 E. 39th Ave., P. O. Box 1020
Idaho, Wallace: 407 Seventh St., P. O. Box 788
Louisiana, New Orleans 25: 7735 Edinburgh St., P. O. Box 13155
Minnesota, Duluth 2: 521 East Superior
Missouri, Kansas City 14: 309 W. 79 Terrace
Montana, Butte: 215 E. Park St.
New York, Buffalo 26: 4532 Bailey Ave.
New York, New York 7: 233 Broadway, Woolworth Bldg.
Ohio, Cleveland 11: 3088 W. 117th St.
Pennsylvania, Hazelton: P. O. Box 17
Pennsylvania, Philadelphia 40: 4309-11 Rising Sun Ave.
Pennsylvania, Pittsburgh 26: 520 McNeilly Rd.
Texas, El Paso: 1704 Paisano Drive
Texas, Dallas 35: 7125 Harry Hines Blvd., P. O. Box 35106
Utah, Salt Lake City: 113 W. Second South St.
Washington, Seattle 4: 615 Eighth Ave. South
Australia, Artarmon, N. S. W.: 70 Hotham Parade
Canada, Edmonton, Alberta: 14415-114
Canada, Moncton, New Brunswick: E. Main St., P. O. Box 475
Canada, Montreal 28, Quebec: 5825 St. James St., W.
Canada, Nelson, B. C.: 745 Baker St.
Canada, Toronto 16, Ontario: 14 Curity Ave.
Canada, Vancouver 9, B. C.: 1775 Pine
Canada, Winnipeg 3, Manitoba: 1400 Sargent Ave.
Northern Rhodesia, Ndola: P. O. Box 18, Alacrity House, Cr. Third St. & Monterey Ave.
Mexico, Mexico City 6, D. F.: Apartado 575
South America, Lima, Peru: Apartado 674
South America, Rio de Janeiro, Brazil: Avenida Churchill 94-B, Caixa Postal 4293
Union of S. Africa: Johannesburg Transvaal: P. O. Box 4807

**Gates Rubber Co., Sales Div., Inc., 999 South Broadway, Denver 17, Colo.**
Alabama, Birmingham 4: 3016 Eighth Ave., North, P. O. Box 1210
Arizona, Phoenix: 2533 West Cypress
Arkansas, Little Rock: 411 Center St.
California, Los Angeles 58: 2850 E. 46th St.
California, South San Francisco: 242 Shaw Rd.
Colorado, Denver 17: 999 So. Broadway
Florida, Tampa: P. O. Box 393
Georgia, Decatur: 3031 E. Ponce de Leon Ave., P. O. Box 889
Illinois, Chicago 32: 3035 West 47th St.
Illinois, Mt. Vernon: 12 North Highland Place
Michigan, Detroit 27: 15844 Schaefer Highway
Minnesota, Minneapolis 3: 638-44 Second Ave., North
Missouri, Joplin: 303 Joplin St.
Missouri, North Kansas City 16: 110 East 9th Ave.
Missouri, St. Louis 9: 3150 Brannon Ave.
Montana, Billings: 404 South 28th St. P. O. Box 2561
New York, Buffalo 3: 79 Swan St.
New York, New York 3: 215-219 Fourth Ave.
Ohio, Cincinnati 29: 814 Melbourne Ave.
Ohio, Cleveland 35: 15400 Industrial Parkway Dr.
Oregon, Portland 10: 2551 N. W. 30th Ave., P. O. Box 9577, Wardway Station
Pennsylvania, Philadelphia 6: 1306 Mall Bldg., 4th & Chestnut Sts.
Pennsylvania, Pittsburgh 22: 26th and Penn Avenue
Tennessee, Knoxville: 317 Gay Street, N. W.
Utah, Salt Lake City: 748 Genessee Ave., P. O. Box 2097
Washington, Spokane 11: 9 Cataldo St.
West Virginia, Huntington 1: 519 Sixth St.
Wisconsin, Green Bay: 414 E. Walnut, 106 Columbus Bldg.
Wisconsin, Milwaukee 8: 831 N. 27th St.

**General American Transportation Corp., 135 South La Salle St., Chicago 90, Ill.**
Alabama, Birmingham: P. O. Box 1870
California, Los Angeles 17: 900 Wilshire Blvd.
California, San Francisco 4: 235 Montgomery St.
Louisiana, New Orleans 12: 210 Baronne St.
Missouri, St. Louis 1: 915 Olive St.
New Jersey, Clifton: Parker-Kalon Div
New York, Buffalo 3: 2008 Rand Bldg.
New York, New York 17: 380 Madison Ave.
Ohio, Cleveland 13: 1307 Terminal Tower Bldg.
Oklahoma, Tulsa: 1005 First National Bank Bldg.
Pennsylvania, Pittsburgh 19: 2612 Koppers Bldg.
Texas, Dallas 2: First National Bank Bldg.
Texas, Houston 2: 919 Bank of the Southwest Bldg.
Utah, Salt Lake City: (Orem Plant) P. O. Box 97, Orem, Utah
Washington, Seattle 1: Joseph Vance Bldg., Third and Union Sts.

**General Tire & Rubber Co., 1708 Englewood Ave., Akron, Ohio**

**Georgia Iron Works Co., Augusta, Georgia**

**B. F. Goodrich Industrial Products Co. Div. of B. F. Goodrich Co, 500 South Main St., Akron 18, Ohio**
California, Los Angeles 22: 3525 S. Garfield Ave.
California, San Francisco 24: 1950 Army St.
Colorado, Denver 4: 2500 W. Eighth Ave.
Georgia, Atlanta 6: 1721 DeKalb Ave. N. E.
Illinois, Chicago 44: 4646 West Lake St.
Kansas, Kansas City 15: 830 Kindelberger Rd.
Michigan, Allen Park: 16500 Oakwood Blvd.
Minnesota, Minneapolis 16: 800 Turners Crossrd.
New York, New York 17: 230 Park Ave.
Ohio, Columbus 14: 3770 Indianola Ave., P. O. 3507
Pennsylvania, Philadelphia 34: 955 E. Erie Ave.
Texas, Dallas 2: 1400 Turtle Creek Blvd., P. O. 6185

**Goodrich Tire Co., B. F., Div. of B. F. Goodrich Co, Akron 18, Ohio**
Alabama, Birmingham 5: 101 S. 12th St.
California, Los Angeles 54: 3525 S. Garfield Ave., P. O. Box 2002, Terminal Annex
California, San Francisco 24: 1950 Army St., P. O. Box 162
Colorado, Denver 4: 2500 W. 8th Ave., P. O. Box 417
Florida, Jacksonville: 2252 Dennis St. P. O. Box 2430
Georgia, Atlanta 7: 1721 DeKalb Ave., N.E., P.O. Box 4509
Illinois, Chicago 44: 4646 W. Lake St.
Indiana, Indianapolis: 1015 E. Michigan St.
Kansas, Kansas City 15: 830 Kindelberger Rd.
Maryland, Baltimore 2: 1266 E. North Ave.
Michigan, Grand Rapids 7: 6 Stuart St., S. W.
Minnesota, Minneapolis 16: 800 Turner's Crossroad So.
Missouri, St. Louis 10: 5051 Southwest Ave.
New York, Albany 1: 1043 Broadway
New York, Buffalo 7: 373 Hertel Ave.
New York, New York 17: 230 Park Ave
North Carolina, Charlotte: Hovis Rd., P.O. Box 2755
Ohio, Cincinnati 41: 2929 Exon Drive
Ohio, Cleveland 35: 15593 Brookpark Rd.
Ohio, Columbus 14: 3770 Indianola Ave.
Oklahoma, Oklahoma City: 301 E. Hill St.
Oregon, Portland 10: 4600 N.W. St. Helens Rd.
Pennsylvania, Harrisburg 14: 700 N. Second St.
Pennsylvania, Philadelphia 34: 955 E. Erie Ave., P.O. Box 4743
Tennessee, Memphis 6: 960 S. Bellevue St., P.O. Box 5687
Texas, Dallas 2: 1400 Turtle Creek Blvd., P.O. Box 6185
Texas, Houston 23: 2830 Produce Row, P.O. Box 1401
Texas, San Antonio 5: 354 E. Commerce St., P.O. Box 1807
Utah, Salt Lake City 4: 651 W. Sixth South St., P.O. Box 1918
Virginia, Richmond 30: Dabney Rd. & Clay St., P.O. Box 6695
Washington, Seattle 24: 1 Hanford St.

**Goodyear Tire & Rubber Co., Akron, Ohio**
California, Los Angeles 22: 6666 E. Washington Blvd.
California, San Francisco 3: 1717 Harrison St.
Colorado, Denver 4: 1207 Wazee St.
Georgia, Atlanta 3: 2755 Piedmont Rd., N.E., P.O. Box 925
Illinois, Chicago 10: 141 W. Ohio St.
Michigan, Detroit 11: 6500 Mt. Elliott Ave.
Minnesota, Minneapolis 40: 418 Stinson Blvd.
Missouri, St. Louis: 8544 Page Blvd.
New York, New York 22: 400 Park Ave.
North Carolina, Charlotte 1: 929-1029 Jay St.
Ohio, Cincinnati 29: 1356 Tennessee Ave.
Ohio, Cleveland: P.O. Box 326, Berea, Ohio
Pennsylvania, Pittsburgh 13: 4760 Center Ave.
Texas, Dallas 35: 7301 Ambassador Row

**Gordon I. Gould & Co., 58 Sutter St., San Francisco 4, Calif.**

**Gould-National Batteries, Inc., Trenton 7, N. J.**
California, La Puente: 14,500 Nelson
California, Oakland: 949 55th St.
Colorado, Denver: 4150 Fox St.
Georgia, Atlanta: Farrar Bldg., 10 N. Claredon Rd., Avondale Estates
Illinois, Chicago: 100 E. Ohio St.
Michigan, Detroit: 3105 E. Grand Blvd.
Missouri, Kansas City: 7941 State Line Rd.
New York, New York: 7 Dey St.
Oregon, Portland: 1973 N. W. Lovejoy St.
Pennsylvania, Philadelphia: 1014 Beury Bldg.
Pennsylvania, Pittsburgh: 1597 Banksville Rd.
Texas, Dallas: 137 Walnut Hills Village
Utah, Salt Lake City: 415 South 2nd East
West Virginia, Huntington: 1111 Vernon St.

## H

**Halliburton Oil Well Cementing Co., 1015 Bois D'Arc St., Duncan, Oklahoma**

**Hammermills, Inc., 625 C Ave., N. W., Cedar Rapids, Iowa**
California, San Francisco: 617 Balboa Bldg.
Colorado, Denver: 3800 So. Sherman, Engiewood
Florida, Melbourne: 637 Lincoln St.
Illinois, Chicago: 2260 Board of Trade Bldg.
Missouri, St. Louis: 7250 Ravinia Dr.
New York, New York: 5720 Empire State Bldg.
Ohio, Cleveland: 19246 Henry Rd., Fairview Park
Texas, Dallas: 3519 Ingleside

**Harbison-Walker Refractories Co., 307 Fifth Ave., Pittsburgh 22, Pa.**
California, San Francisco 5: 625 Market
Massachusetts, Boston 10: 10 High St.
Michigan, Detroit 35: 17601 James Couzens Highway
Missouri, St. Louis 1: 1325 Ambassador Bldg.
New York, New York 5: 68 William St.
Pennsylvania, Philadelphia 3: 981 Suburban Station Bldg.
Pennsylvania, Pittsburgh 22: 307 Fifth
Texas, Houston 25: 1319 Prudential Bldg.
Canada, Ontario, Hamilton: 105 Walnut St., South
Canada, Quebec, Montreal 2: Room 540, Canada Cement Bldg.

**Hardinge Co., 240 Arch Street, York, Pa.**
California, San Francisco 11: Room 720, 24 California St.
Illinois, Chicago 6: 1907 Engineering Bldg., 205 W. Wacker Dr.
Minnesota, Hibbing: P. O. Box 368
New York, New York 17: 3906 Chanin Building, 122 E. 42nd St.
Utah, Salt Lake City 15: 333 W. 14th South St.
Canada, Ontario, Toronto 1: 44 Victoria St.

**Harnischfeger Corp., 4400 W. National Ave., Milwaukee 46, Wis.**
Alabama, Birmingham 4: 1629 Vanderbilt Rd., Box 1150
Arizona, Phoenix: Room 252, 3300 N. Central Ave.
California, Los Angeles 59: 2400 East Imperial Highway
California, San Francisco: 212 Shell Bldg., 100 Bush St.
Colorado, Denver: Room 610, Central Bank Bldg., 1108 15th St.
Florida, Miami 56: 12035 South Dixie Highway
Georgia, Atlanta: Luckie Bldg., 361 E. Paces Ferry Rd.
Illinois, Chicago 6: 110 North Wacker Dr.
Kentucky, Louisville 2: Room 406, Republic Bldg., 429 W. Walnut
Massachusetts, Boston 82: 350 Washington St., Wellesly Hills
Michigan, Detroit 35: 17618 West McNichols Rd.
Minnesota, Duluth 2: 407 Bradley Bldg.
Minnesota, Minneapolis 8: 2614 Nicollet Ave.
Mississippi, Jackson: 309 Vincent Bldg.
Missouri, Kansas City 5: Rooms 604-5, 1012 Baltimore Bldg.
Missouri, St. Louis (in Clayton 5): Room 202, Brown Bldg., 101 South Meramec Ave.
New Jersey, Teterboro: 100 North St.
New York, New York 7: Room 730, Hudson Terminal Bldg., 30 Church St.
Ohio, Cincinnati 37: Roselawn Center Bldg., Reading & Section Roads
Ohio, Cleveland 14: Rooms 1201-2, Superior Bldg., 815 Superior Ave., N. E.
Ohio, Dayton: 53 Park Ave.
Pennsylvania, Philadelphia 3: 944 Suburban Office Building
Pennsylvania, Pittsburgh 16: 1428 Banksville Rd.
Texas, Dallas 7: 1225 North Industrial Blvd.
Virginia, Roanoke: 228 Shenandoah Bldg.
Washington, Seattle 4: 2909 First Ave., South
Wisconsin, Milwaukee 46: 4601 W. Beloit Rd.

**Hendrick Manufacturing Co., Carbondale, Pa.**
Pennsylvania, Hazelton: 531 N. Locust St.
Pennsylvania, Pittsburgh: P. O. Box 10540

**Hercules Powder Co., 900 Market St., Wilmington 99, Del.**
Alabama, Birmingham 3: First National Building, 17 N. 20th St.
California, Los Angeles 5: 3460 Wilshire Blvd.
California, San Francisco 4: 120 Montgomery St.
Illinois, Chicago 4: McCormick Bldg., 332 S. Michigan Ave.
Minnesota, Duluth 2: Torrey Bldg., 314-16 W. Superior St.
Missouri, Joplin: First National Bank Bldg., 404 Main St.
New York, New York 17: 380 Madison
Pennsylvania, Pittsburgh 22: 2 Gateway Center, 603 Stanwix St.
Utah, Salt Lake City 1: Kearns Bldg., 136 S. Main St.

**Hewitt-Robins, Inc., 666 Glenbrook Rd., Stamford, Conn.**
Alabama, Birmingham: 3118 3rd Ave. South
Arizona, Phoenix: 207-B Camelback Rd.
California, Los Angeles: 2604 S. Malt Ave.
California, San Francisco 5: 55 New Montgomery St.
Colorado, Denver: 5075 Colorado Blvd.
Illinois, Melrose Park: 17th & Bloomingdale
Indiana, Indianapolis 22: 2813 Questend S. Dr.
Kentucky, Louisville 7: 319 Foeburn Lane
Louisiana, Bossier City: 4003 Lark St.
Louisiana, New Orleans 14: 109 Cambridge St., Aurora Gardens
Michigan, Ferndale 20: 1840 Hilton Rd.
Minnesota, Hibbing: 718 E. Howard St.
Minnesota, Minneapolis: 3418 East Lake St.
Missouri, Kansas City 11: 312 VFW Bldg., 406 W. 34th St.
Missouri, St. Louis 10: 4030 Chouteau Ave.
New York, New York: 370 Lexington Ave.
North Carolina, Charlotte 6: P.O. Box 5277
Ohio, Cleveland 14: 314 Superior Ave., NE
Oklahoma, Tulsa: 310 Thompson Bldg.
Oregon, Portland: 305 S.W. 3rd Ave.
Pennsylvania, Ft. Washington: Ft. Washington Park
Pennsylvania, Pittsburgh 19: 951-952 Union Trust Bldg.
Tennessee, Memphis 17: 5111 Sea Isle
Texas, Houston 11: 5711 Navigation St
Virginia, Richmond: 6002-A West Broad St., Rm 201
Washington, Seattle: 641 Dexter Horton Bldg.
West Virginia, Bluefield: 1417 College Ave.
West Virginia, Charleston 4: P.O. Box 4207
West Virginia, Fairmont: 196 Broadview Ave.

**Hoffman Bros. Drilling Co., Inc., Tiona St., Punxsutawney, Pa.**

**Huber-Warco Co., Marion, Ohio**

## I

**Industrial Equipment Div., Baldwin-Lima-Hamilton Corp., Philadelphia National Bank Building, Philadelphia 7, Pa.**
California, Los Angeles 17: 600 St. Paul Ave.
California, San Francisco 10: 2929 19th St.
D. C., Washington 6: 1000 Connecticut Ave., N. W.
Illinois, Chicago 4: 627 Railway Exchange Bldg.
Missouri, St. Louis 3: 1221 Locust St.
New York, New York 3: 111 Fifth Ave.
New York, Schenectady: 509 State St.
Pennsylvania, Philadelphia 42
Pennsylvania, Pittsburgh 19: 1098 Union Trust Bldg.
Texas, Dallas 7: 2356 Irving Blvd.

**Industrial Physics & Electronics Co., 470 S. 10th St., Salt Lake City, Utah**

**Ingersoll-Rand Co., 11 Broadway, New York 4, N. Y.**
Alabama, Birmingham 3: 1700 Third Ave., South
California, Los Angeles 22: 5533 Olympic Blvd.
California, San Francisco 7: 350 Brannan St.
Colorado, Denver 2: 1641 Blake St.
Illinois, Chicago 6: 400 W. Madison St.
Louisiana, New Orleans 25: 960 Genois St.
Michigan, Detroit 26: Congress at First
Minnesota, Minneapolis 4: 2020 Snelling Ave.
Missouri, Kansas City 5: 1012 Baltimore Ave.
Montana, Butte: 845 S. Montana St.
New York, New York 4: 11 Broadway
New York, Buffalo 2: 117 W. Chippewa St.
Ohio, Cleveland 3: 4506 Chester Ave.
Oregon, Portland 5: Room 1004 Broadway Bldg.
Pennsylvania, Pittsburgh 22: 932 Penn
Tennessee, Knoxville 24: 412 W. Jackson Ave.
Texas, Dallas 1: 1728 Canton St.
Texas, El Paso: 2100 Wyoming St.
Utah, Salt Lake City 1: 144 S.W. Temple St.
Virginia, Richmond 30: 3431 W. Leigh St.
Washington, Seattle 4: 527 First Ave. South

**International Bartering Corp., 52 Broadway, New York 4, N. Y.**

**International Harvester Co., 180 Nort Michigan Ave., Chicago 1, Ill.**
Alabama, Birmingham 2: 931 North 24th St., P. O. Box 2573
Arkansas, Little Rock: 3601 West 65th St., P.O. Box 2541
Colorado, Denver 17: 4233 East 46th Ave., P. O. Box 5028
Florida, Jacksonville 1: 1986 West Beaver St., P. O. Box 869
Georgia, Atlanta 2: 580 Whitehall St., S. W. P. O. Box 4297
Kentucky, Louisville: 1326 West Walnut St.
Minnesota, Minneapolis: 2572 University Ave., St. Paul 14, Minnesota
Minnesota, St. Paul 14: 2572 University Ave.
Missouri, Hazelwood: 5902 No. Lindbergh Blvd.
Montana, Billings: 20 South Broadway
Oklahoma, Oklahoma City 1: 5125 West Reno Ave., P.O. Box 1337
Tennessee, Memphis 2: 237 West Olive Ave., P. O. Box 2864
Texas, Amarillo: 714 East 10th St.
Texas, Dallas 15: 1809 South Lamar St.
Texas, Houston 1: 4619 Navigation Blvd., P. O. Box 1425
Utah, Salt Lake City 10: 435 West Fourth South St., P. O. Box 660
Washington, Spokane 3: 715 East Sprague Ave.

**International Nickel Co., 67 Wall St., New York 5, N. Y.**

**Iowa Manufacturing Co., 916 16th St., N.E., Cedar Rapids, Iowa**

## J

**Jenkins Bros., 100 Park Ave., New York 17, N. Y.**
California, San Francisco 4: 1410 Russ St.
Georgia, Atlanta 3: 1603 Fulton National Bank Bldg.
Illinois, Chicago 4: 1520 Board of Trade Bldg.
Massachusetts, Boston 10: 75 Federal St.
Pennsylvania, Philadelphia 4: 1624

**Johns-Manville Corp., 22 East 40 St., New York 16, N. Y.**

**Joy Manufacturing Co., 333 Henry W. Oliver Bldg., Pittsburgh 22, Pa.**
Alabama, Birmingham: 601—10th St. North
California, Los Angeles 22: 5426 E. Washington Blvd.
California, San Francisco 3: 1155 Harrison St.
Colorado, Denver 2: 1626 Wazee St.
Illinois, Chicago 6: 560 W. Washington Blvd.
Massachusetts, Burlington: Second Ave.
Minnesota, Duluth 2: 1021 E. Superior St.
Missouri, St. Louis 10: 1203 Macklind Ave.
Montana, Butte: 24 W. Granite St.
New Mexico, Grants: San Mateo Rd.
New York, New York 7: 100 Church St.
Oregon, Portaland 9: 1631 N. W. Thurman St.
Pennsylvania, Luzerne: 453 Main St.
Pennsylvania, Philadelphia 2: 1420 Walnut St.
Pennsylvania, Pittsburgh 16: 3021 Banksville Rd.
Tennessee, Knoxville 2: 108 W. Main St.
Texas, Dallas 20: 7425 Hines Blvd.
Texas, El Paso: 1022 Wyoming St.
Utah, Salt Lake City 4: 998 South Sixth West St.

## K

**KW-Dart Truck Co., 1301 North Manchester Trafficway, Kansas City, Mo.**
New York, Long Beach: 23 Virginia Ave.
Ohio, Cleveland: West Lake Hotel
Ohio, North Ridgeville: 34554 Lorain Rd.

**Kaiser Engineers, 300 Lakeside Dr., Kaiser Center, Oakland 12, Calif.**
Illinois, Chicago 1: 228 North Lasalle St.
New York, New York 22: 300 Park Ave.
Pennsylvania, Pittsburgh 19: Rm. 3301 Grant Bldg., 330 Grant St.

**Kellogg Co., M. W., 711 Third Ave., New York 17, N.Y.**

**Kennedy Van Saun Mfg. & Eng. Corp., 405 Park Ave., New York 22, N. Y.**
Pennsylvania, Danville

## L

**Le Roi Div., Westinghouse Air Brake Co., Milwaukee 1, Wis.**
California, Oakland 12: Rm. 811 Easton Bldg., 428-13th St.
Colorado, Denver 3: 610 Farmers Union Bldg.
Georgia, Atlanta 3: 1621 Candler Bldg.
New York, New York 20: 45 Rockefeller Plaza
Ohio, Cleveland 9: 4798 W. 35th St.
Oklahoma, Tulsa 19: Suite 307-A IBM Bldg., 1307 South Boulder
Ontario, Downsview: 465 Wilson Ave., West.

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California, La Mirada: 14120 East Rosecrans Ave.
Georgia, Atlanta 18: P.O. Box 2561, Station D
Indiana, Michigan City: 2503 Lake Shore Dr.
Minnesota, Minneapolis: 2018 West 78 St.
New York, New York 3: 111 Fifth Ave.
Texas, Dallas 7: 2356 Irving Blvd.
Washington, Seattle 4: 1932 First Ave., South

**Linatex Corp. of America, Stafford Springs, Conn.**
Canada, Quebec, Montreal 9: 1975 Bois Franc Rd., Wilkinson Linatex Co.

**Link-Belt Co., Dept. 60, EMBGL 1700 Prudential Plaza, Chicago 1, Ill.**
Aalabama, Birmingham 9: P.O. Box 6060, 1812 28th Ave., South
California, Los Angeles 22: P.O. Box 22056 (1200 Sycamore St., Montebello)
Californa, San Francisco 24: 400 Paul Ave.
Colorado, Denver 2: 1626 Wazee St.
Florida, Jacksonville 2: 137 E. Forsyth St.
Georgia, Atlanta 10: 1116 Murphy Ave., S. W., P.O. Box 10514, Station A
Illinois, Chicago 9: 301 W. Pershing Rd.
Illinois, Moline: 1614½ Fifth Ave.
Kentucky, Louisville 8: 235 E. Burnett St.
Louisiana, New Orleans 16: 2025 Canal St.
Louisiana, Shreveport: 3109 Alexander St.
Maryland, Baltimore 12: 7215 York Rd.
Minnesota, Duluth 2: 301 W. First St.
Minnesota, Minneapolis 5: 200 Lyndale Ave. N.
Missouri, Kansas City 8: 2630 Holmes St.
Missouri, St. Louis 1: 317 N. Eleventh St.
New Jersey, Summit: 293 Morris Ave.
New York, New York 36: 530 Fifth Ave.
North Carolina, Charlotte 2: 112 S. Tryon St.
Ohio, Cincinnati 2: 138 E. Court St.
Ohio, Cleveland 20: 3592 Lee Rd.
Oregon, Portland 10: 3030 N.W. Industrial St.
Pennsylvania, Philadelphia 40: 2045 W. Hunting Park Ave.
Pennsylvania, Pittsburgh 13: 5020 Centre Ave.
Texas, Dallas 26: 500 Good-Latimer Exp.
Texas, Houston 1: 3203 S. Wayside, P.O. Box 2563
Utah, Salt Lake City 1: 108 S. Fourth W. St.
Washington, Seattle 4: 3405 Sixth Ave. S.
Washington, Spokane 10: N. 1303 Washington St.
Wisconsin, Milwaukee 3: 808 N. Third St.

**Link-Belt Speeder (Canada) Ltd., Woodstock, Ont. Canada**
Canada, Edmonton, Al.: 10019-103rd St., P.O. Box 11
Canada, Elmira, Ont.: 19 Church St. E.
Canada, Halifax, N.S.: Austen Bros. Ltd., 118 Hollis St.
Canada, Hamilton, Ont.: 650 James St. N.
Canada, Montreal 15, Que.: 945 Beaumont Ave.
Canada, Scarboro (Toronto 13): Ont.: 1960 Eglinton Ave. E., P.O. Box 173
Canada, Swastika, Ont.: 8 Boisvert St.
Canada, Sydney, N.S.: Austen Bros. Ltd., 361 George St.
Canada, Vancouver 12, B.C.: 2550 Boundary Rd.
Canada, Winnipeg 10, Man.: 1315 Portage Ave.
Australia, Marrickville (Sydney) N.S.W.: Rich St., P.O. Box 41
Union of South Africa, Springs, Transvaal: P.O. Box 287, Industry Rd., New Era, Springs
Brazil, Sao Paulo: Rua Barao de Itapetininga, 46-60 Andar, Caixa Postal 7051

**Logan Engineering Co., 4901 West Lawrence Ave., chicago 30, Ill.**

**E. J. Longyear Co., 76 South 8th St., Minneapolis 2, Minnesota**
Utah, Salt Lake City 10: 1177 South 2nd West

**Lubriplate Div., Fiske Bros. Refining Co., 125 Lockwood St., Newark 5, N. J.**
Ohio, Toledo 5

## M

**Machinery Center, Inc., 1201 S. 6th West St., P. O. Box 964, Salt Lake City 1, Utah**
Washington, Chelan: P. O. Box 762
Canada, Winnipeg, Manitoba: 416 Ave. Bldg.

**Mack Trucks, 1355 West Front Street, Plainfield, N. J.**
Alabama, Birmingham: 2820 Sixth Ave., So. (P. O. Box 1009)
California Arcata: 50 South "G" St. (P. O. Box 457)
California, Los Angeles: 2001 S. Alameda St.
California, Palo Alto: 499 Hamilton Ave.
California, San Francisco: 1745 Folsom St.
Colorado, Denver: 4850 Vasquez Blvd.
Florida, Jacksonville: 2203 West Beaver St. (P. O. Box 2880)
Florida, Tampa: 604 So. Morgan St. (P. O. Box 1404)
Georgia, Atlanta: 780 Memorial Drive, S. E.
Illinois, Chicago: 33rd St. & Wentworth Ave.
Indiana, Indianapolis: 1810 W. 16th St.
Kentucky, Louisville: 225 East Walnut St.
Louisiana, New Orleans: 1001 So. Jefferson Davis Pkway.
Michigan, Detroit 10401 Ford Rd., Dearborn
Minnesota, St. Paul: 2505 University Ave. (Midway)
Missouri, Kansas City: 3738 Gardner Ave.
Missouri, St. Louis: 2350 Chouteau Ave.
New Jersey, Newark: 1239 Broad St.
New York, Albany: 1064 Broadway
New York, Buffalo: 267 Michigan Ave.
New York, Newburgh: P. O. Box 791, MD 15, Route 17K
New York, Poughkeepsie, 205 Delafield St. (P. O. Box 471)
New York, Syracuse: East Erie Blvd.
North Carolina, Charlotte: 228 Dalton Ave. (P. O. Box 1967)
Ohio, Akron: 1100 Triplett Blvd. (P. O. Box 7155)
Ohio, Cincinnati: 1223 W. 8th St.
Ohio, Cleveland: 13600 Broadway
Oklahoma, Oklahoma City: 1816 N. E. 10th St.
Oregon, Eugene: 933 Franklin Blvd. (P. O. Box 1108)
Oregon, Portland: 1122 N. Williams Ave.
Pennsylvania, Erie: 960 West 12th St.
Pennsylvania, Harrisburg: 2020 Paxton St.
Pennsylvania, Philadelphia: 2647 East York St.
Pennsylvania, Pittsburgh: 728 Shore Ave.
Texas, Dallas: 901 So. Akard St. (P. O. Box 1528)
Texas, Fort Worth: 2812 North Main St. (P. O. Box 4501)
Texas, Houston: 5331 Gulf Freeway (P. O. Box 18515)
Utah, Salt Lake City: 704 South Third West St.
Virginia, Richmond: 1705 Ninth Street Road
Washington, Seattle: 3707 Airport Way
West Virginia, Charleston: 5800 McCorkle Ave., S. E.
Canada, Montreal: 2150 Cote de Liesse Road
Canada, Regina, Sask.: 1333 McIntyre St.
Canada, Toronto, Ont.: 45 Strachan Ave.
Canada, Winnipeg, Manitoba: 301 Princess St.

**Magor Car Corp., 50 Church St., New York 7, N. Y.**
California, San Francisco 11: 1045 Sansome St.

**Mancha Storage Battery Locomotive Div., Goodman Mfg. Co., Halstead St. & 48th Pl., Chicago 9, Ill.**
Alabama, Birmingham: 812 Fifth Ave., N.
Pennsylvania, Pittsburgh: 1714 Liverpool St.
Pennsylvania, Wilkes Barre: 35 New Bennett St.
West Virginia, Huntington: 831 Second Ave.
Canada, North Bay, Ontario: Mancha Locomotive, Div. of Goodman Mfg. Co. of Canada, Ltd.

**Marion Power Shovel Co., A Div. of Universal Marion Corp., 617 W. Center St., Marion, Ohio**
Arizona, Phoenix: 1017 N. 22nd Ave.
California, S. San Francisco: 326 Shaw Rd.
Florida, Ft. Lauderdale: 3300 Southwest 22nd St.
Illinois, Chicago 4: Room 1404, McCormick Bldg., 332 S. Michigan Ave.
Indiana, Indianapolis 26: 5202 E. Dickson Rd.
Louisiana, New Orleans 14: 2500 Bristol Place
Massachusetts, Wellesley Hills 82: 89 Wellesley Ave.
Minnesota, Excelsior: Route 3
Missouri, Kansas City: Room 309, 1016 Baltimore Ave.
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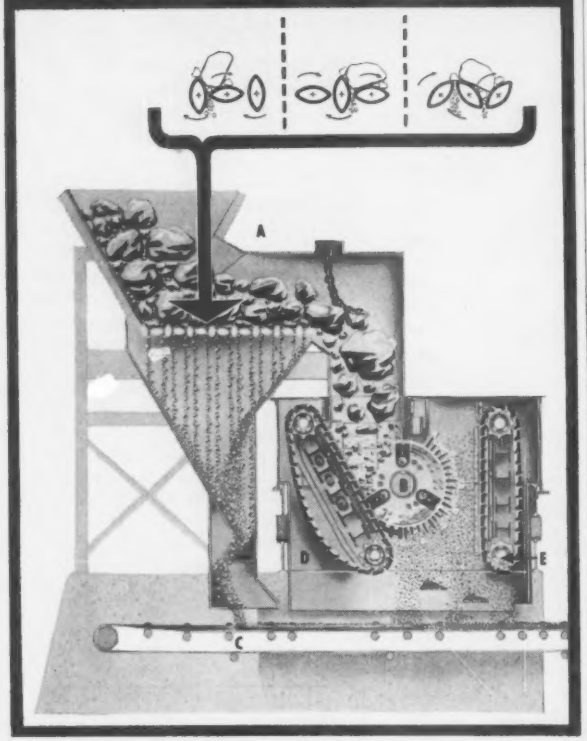


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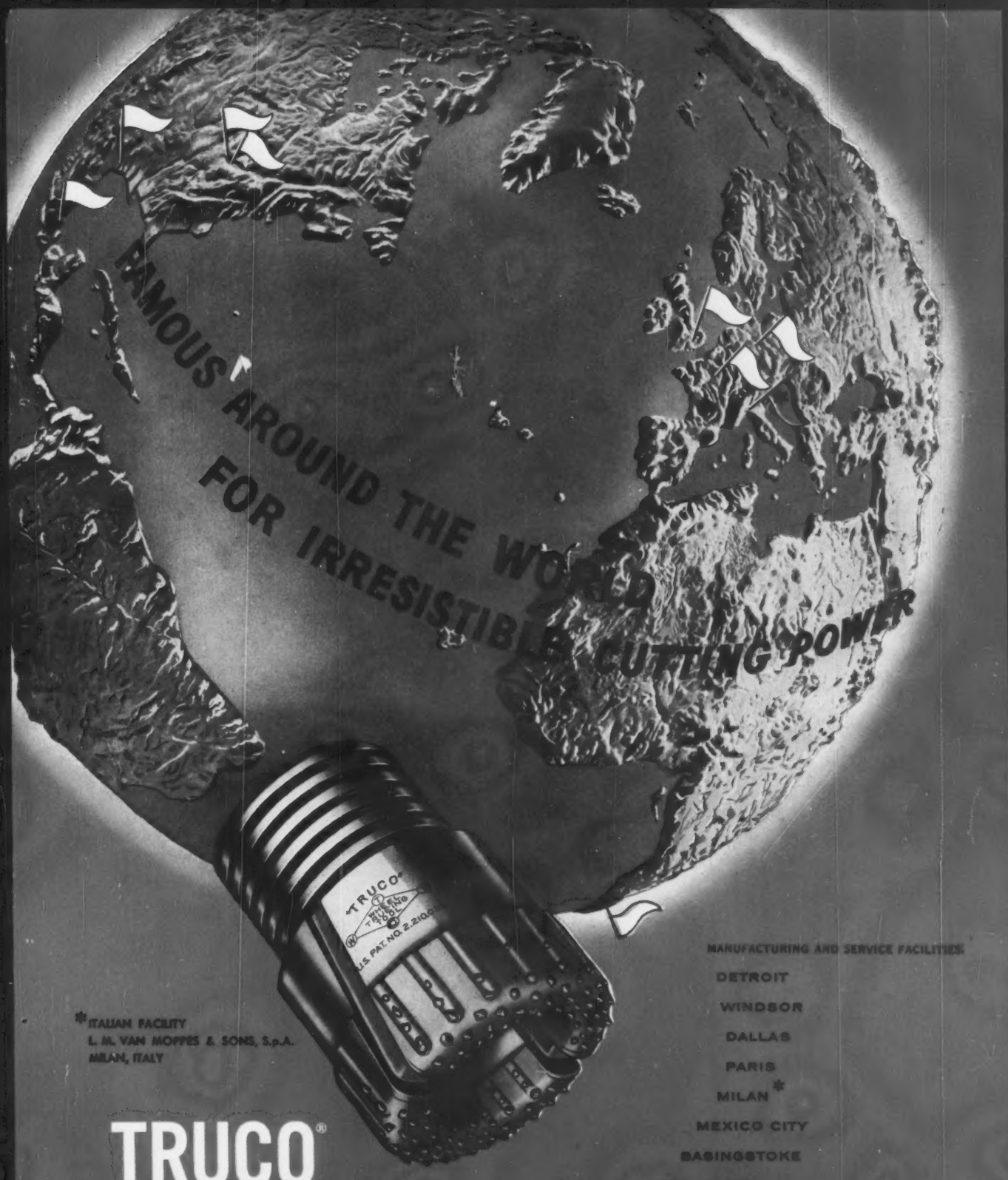


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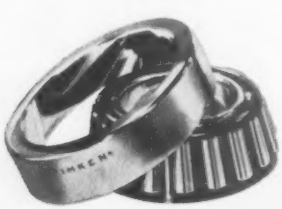

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